Leicester Grammar School's

YOUNG SCIENTISTS journal

Your Prescription Today and Everyday: Laughter

An article investigating the effectiveness of laughter as a means of treatment

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Coltan, Congo, Conflict

An article discussing the connection between your mobile phone and human rights abuses in Africa

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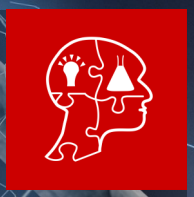

"The LGS Young Science Journal team would like to warmly welcome you to the third issue of this academic year. Undoubtedly, it has been an unexpected year for the journal, with online meetings and communicating via email. But despite all the odds, we have continued to thrive. Through the lockdown period, we have had an increase in interest and submission of articles; we hope to continue this upward trajectory as we progress into the future.

Many students ask how they can contribute to the journal. There are many ways to get involved, whether it be through building experiments, books reviews, photography for the front covers, blogging or the more traditional, article writing. But the journal's identity is centred around the people involved – it's down to your passions and your interests. We encourage you to look analytically at the world around you, and question what is going on around us. Ideas and topics to write about or photograph can stem from the weirdest of places. This issue explores a variety of topics, including Gravity, Agriculture, Touchscreens, Coltan, Big Data, Psychedelics, Spaceflight, Laughter, and BME Health inequalities. In addition, this year we have received several articles regarding the current Covid-19 pandemic, which have highlighted and analysed key issues, problems and policies. We encourage future LGS Young Science Journal writers to look at these articles in a couple of years' time, when more events have unfolded, to further develop this ongoing story.

The journey of this journal has been remarkable. We have come a long way since our humble origins in September 2017. This edition marks the last for the current LGS YSJ Team. We are proud to introduce next year's team: Georgina Holmes and Gabrielle Samanta as editors, Annabelle Onion and Saniya Bhatt as advertisers. As the next year's team begins to 'take the reins', we wish them luck and look forward to a fresh set of brains to bring new ideas and developments to the table. It has been a joy and a privilege to play a part in the journal's growth and we hope to see it continue to blossom and spread its wings.

In the new academic year, we hope to restart holding regular meetings during break and lunch times, which you will be informed of in the morning notices. Alternatively feel free to drop any of the team or Mr Reeves an email if you would like to get involved.

As the editorial team, we would like to thank you for all your readership and efforts for the journal, and bid you well in all your scientific endeavours. We would also like to thank Mr Reeves for his guidance, advice and support. Both of the current editors finish our time at LGS, but leave with the satisfaction that the journal is in capable hands. Good Luck!

We would like to acknowledge the following for their contribution:

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Articles in this issue:

Who are We?

We are a collection of Leicester Grammar School students who have come together to produce a variety of pieces of writing about the world of STEM. As a school, we have become a hub for the Young Scientists Journal, an international peer-review written and edited entirely by young people.

Contact Us

Anyone interested in joining the YSJ to help to write, edit and publish is more than welcome to meet us at our meetings during lunchtimes (specific details will be in the daily notices). We welcome submissions from all year groups on any scientifically-related topic; so come along to a meeting or email us at:

lgsyoungscientists@gmail.com

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Front Cover Photo Provided by Declan Musto

The problems in Latin America's COVID-19 Response

Akshay Patel explores examples of the rejection of Scientific reasoning in the Latin-American COVID-19 response

The New COVID-19 Epicentre

After starting in Wuhan, China, the COVID-19 virus spread westwards, and now as Asia and Europe seek to ease restrictions and return to normality, the World Health Organisation declared Latin America as the "new epicentre" of the crisis. Case numbers have reached 1.5 million (a conservative estimate) and death figures have exceeded 100000 and show no sign of slowing down. There has been a failure in Latin America's COVID-19 response, and this comes down to governmental decisions based on politics and economics instead of science.

As I outline the issues in the Latin American COVID-19 response, using examples of different countries, it is important to note that there is a significant minority of countries whose responses have been objectively successful. Argentina, Colombia, Costa Rica and Uruguay have been the successful exceptions amongst their Latin American neighbours. This shows that with proper policy and preparation, and basing a response on scientific fact, it was possible for there to be a successful COVID-19 strategy in Latin America. This suggests that other countries, such as Brazil, Nicaragua, Peru and Mexico, who have been less successful in their responses, could have prevented unnecessary losses of life.

The Pre-Crisis Situation

Before examining the response to the COVID-19 crisis, first it is necessary to look at Latin America's ability to resist the virus. Unfortunately, Latin America is one of the most vulnerable regions on the planet to a highly contagious virus. This stems from socio-economic problems and slow growth plaguing the region for many years. In 2019 the Latin-American economy grew by a low 0.1%. The area has the highest level of wealth inequality in the world, only matched by Sub-Saharan Africa. Poverty is rife in Latin America with over 30% (192 million) of the population below the poverty line and 10% of the population living in extreme poverty. This results in a hygienic disaster; cramped living conditions, limited access to running water and lack of sanitation. This is the perfect breeding ground for any virus and exacerbates COVID-19's contagious nature. In addition to this, the Latin American healthcare systems were overburdened and underfunded before the crisis, they would be unable to cope. These factors mean that even before a response was needed, Latin America was incredibly ill-equipped to deal with COVID-19.

Problematic Populist Politics

Scientific ignorance in favour of economics and politics has been seen all over the world to varying degrees. In Latin America initially this occurred in lots of countries but particularly consistently Brazil and Nicaragua. Brazil's right-wing president Jair Bolsonaro has been equally as ignorant of scientific fact in his covid-19 response. in March he described the virus as "a little flu" and since then stated on national television, "the people will soon see that they were tricked by these governors and by the large part of the media when it comes to coronavirus," referring to governors in Rio de Janeiro and Sao Paolo declaring a state of emergency in their respective states. Jair Bolsonaro has frequently criticized governors for attempting to enforce lock down and social-distancing measures, insisting that the economy comes first. Despite the fact that there have been over 55,000 deaths in Brazil (although this is likely to be a vast underestimation), the president has maintained his stance of suggesting that defence against virus should not be prioritised over economic activity and growth. Bolsonaro like other Latin American leaders fear that the certain economic downturn a lockdown would cause would hamper their popularity and may force them to give up power.

Somewhat ironically, the crisis response of the Nicaraguan left-wing government, led by Daniel Ortega, has been remarkably similar to that of the right-wing Brazilian government. The government, against all suggestions of the World Health Organisation, encouraged large-scale public events and has not closed schools and has not implemented a lockdown or social distancing policies. The government

declared it was approaching the pandemic with policies that would promote herd immunity (proven to be counterproductive by Sweden whose case and death rates are higher than the other fellow pro-lockdown Scandinavian countries), rather than suppression. On April 30th, Ortega said he was against public campaigns that urged people to stay at home and called those who encouraged such measures "radicals" and "extremists" who "only want to see the country destroyed". He also suggested that his opponents calling for more action are trying to cause instability and a financial crisis to undermine his government. In addition to this the government has been grossly underreporting the death toll. Official figures state there have been 74 deaths whereas independent reporting suggests that there have been over 1300. Deaths have been concealed with vast hidden burials. Authorities deny COVID-19 is the cause and blame "atypical pneumonia". In several cases families are not allowed to attend the burials. Perhaps the biggest problem is the censorship of all doctors and health-workers who disagree with Ortega's policies and try to communicate the extent of the crisis to the Nicaraguan people. On June 6th and 9th several medical workers were dismissed without legal procedures by the Nicaraguan Health Ministry. This is an act to defend the Ortega administration's handling of the pandemic and hide the unnecessary loss of life.

Failing Public Healthcare Systems

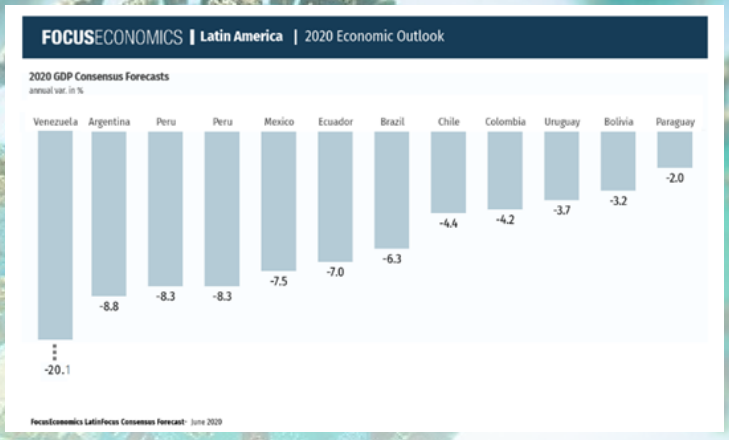
Against a pandemic a nation's healthcare system is the backbone of the response and its effectiveness determines the successfulness of the response. In the Latin America region, Peru is one of the worst hit countries with confirmed cases approaching 300,000 and over 9000 deaths. Despite an aggressive lockdown implemented earlier than any other Latin American country (12th March after a mere 84 cases), it was the collapse of the healthcare system that led to catastrophe. After over 12 weeks of lockdown, infection figures have kept rising. This can be attributed to the fact that there was widespread flouting of restrictions due to workers forced to work by companies in order to protect their livelihoods. Infections were not being curtailed and the fragile, chronically underfunded Peruvian healthcare system inevitably failed, crippled by the influx of cases. Due to a combination of lack of protective equipment and failure to follow health safety protocols, the virus has spread rapidly among health care workers. At least 70 doctors and 1,200 nurses contracted the disease, and over 40 health-care workers have died. There is a small private health sector in Peru, but only the richest can afford this higher standard of care. The majority rely on rudimentary primary care provided by the underfunded public health sector. Capacity is very low, in Peru there are only 1.6 hospital beds per 1000 people in the country and only 1000 ICU beds in total (for a population of 32 million). This has resulted infected elderly are being turned away from hospital, with younger patients prioritised instead. Peru is an example of a country that while the Government implementing strict measures, they have proved ineffective due to the lack of preparedness and infrastructure regarding the healthcare system.

Health care is a merit good, and in a free market, merit goods are undersupplied. Theoretically, state supplied healthcare should solve this problem by providing healthcare to all, but this requires large public investment and government spending. Critical underfunding in such an important public sector service, as seen in Peru, means that the service is normally always close to full capacity. With a shock such as the COVID-19 pandemic, the skyrocket in demand meant that it was destined to fail. Despite pledges by the government to improve the system, the time lag on infrastructure projects means that the damage will have already been done. Similar problems of struggling health care systems are seen all over Latin America such as in Chile whose healthcare system is beyond full capacity and the percentage of the population infected is amongst the highest in the world. Even worse is the situation in Venezuela, where many hospitals struggle to have regular access to fresh water and electricity. In addition to this over the past decade there has been a mass exodus of medical professionals as they search of better pay and a better life. Strong health care systems are the obvious backbone in a response against a pandemic and in Latin America many countries have not had this. No matter how strict of a lockdown a country undergoes, without care for those infected and proper equipment to provide this, the virus' effects will be more widespread.

A Premature Return to Normality?

A return to normality is on the mind of all countries in the world. However, a premature end of restriction and end of

lockdown could spell disaster for a country's COVID-19 response. Mexico is a country that may be falling victim to this. The initial Mexican response to the COVID-19 crisis was far from ideal. Mexico's president Andres Manuél Lopez Obrador suggested in March that reports of the COVID-19 were being falsely conjured by political opposition to undermine his leadership. However, with the rate of daily cases and deaths still rising in Mexico, Obrador decided to start the easing of restriction. A higher peak is seemingly inevitable. The reason for a seemingly premature end to COVID-19 restrictions is entirely based on the government's desire to limit the economic damage caused by the virus. This economic damage has ben felt all over the world, due to a severe unexpected curtailment in demand. This results in a falling aggregate demand leading to lower growth or economic contraction. This is especially prevalent in the less economically developed economies as much demand is for products in markets rather than online, via deliveries. In Mexico's economy the large tourist industry has been severely hit due to international travel restrictions. The fall in aggregate demand in Mexico, and Latin America as a whole, and its negative effect on growth is shown by the June 2020 GDP forecast of the area (see graph). This dire economic projection means that some countries were slow to implement lockdown and wish to end it as soon as possible in order to preserve aggregate demand levels and negate economic contraction. However, in the case of Mexico, this has been done far too prematurely with no regard to the consistently rising case and death rates. Here is an example where scientific evidence and models of infection levels and death rates have been rejected in favour of economic growth. Unlike other countries around the world that have accepted the prospect of a recession and decided to implement fiscal measures via borrowing, some Latin American countries have chosen to avoid economic contraction, no matter the cost.



What do these examples show?

It can be argued that the COVID-19 pandemic is a crisis that is new and so all responses would inevitably have their flaws. However, in political and economic terms, such crises are not new and have been felt in the past century. Demand deficient economic problems occurred in both the Great Depression of the 1940's (caused by the Markets crashing) and the 2007-2009 Great Depression (caused by the sub-prime mortgage crisis). In both cases, expansionary fiscal measures in the form of government spending was required to rescue world economies. Clearly the COVID-19 crisis, and the resulting demand deficient economic problems, will require immense government borrowing and spending as response to the global economic contraction. Some Latin American countries, however, are unwilling to take such measures and instead try to increase the demand in their economies by not implementing strict societal measures to fight the virus. This ignores the medical advice provided by scientific data and as a result will cause a loss of life that was preventable. This attitude is also seen in the failing healthcare systems where governments were unwilling to spend on a public service due to its lack of profitability and have suffered as a result. Finally, in the case of some countries, scientific reason is ignored, and the public are denied information, all in order for leaders to maintain their grasp on power. In many Latin American countries, the combination of a large proportion of the population living poverty, and ignorant, short-sighted policy decisions have proven fatal. The lack of financial security and spending provided to people by their governments mean that in the poverty-stricken Latin America, people they have no choice but to work and endanger their health, in order to provide for themselves and their families.

The scientific evidence is blindingly clear to all involved. Often governments show rising numbers of cases and deaths in official figures while their leaders suggest the pandemic is farcical. This does not bode well for the future of crisis response. The other crisis of our time has the potential to be more fatal than even than the COVID-19 crisis. The climate crisis has been ongoing for a number of years and many leaders reject its legitimacy despite proven scientific evidence. If leaders can ignore the death and suffering of people in their country, it is more than likely that the climate crisis, with far more subtle, slower but nonetheless deadly effects, may be ignored too. If this

occurs, by the time action is taken, it may be too late. The damage caused will supersede countries and may have a large toll on humanity.

Akshay Patel

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How Agriculture became our Killer

Georgina Holmes discusses how agriculture has led to a greater prevalence of diseases

11,500 years ago (at the end of the last ice age) humanity made one of its greatest leaps in innovation: agriculture. Previously hunter-gatherers, bands of early Homo Sapiens gradually adopted the practice of domesticating crops over thousands of years. Completely independently, peoples across the world adopted agriculture at vastly different times – the latest being the Australian aborigines, who were still hunter-gatherers when the first imperial soldiers arrived in the 19th century – but it's origins lie in the Fertile Crescent of the Middle East. It is likely that the change in climate when the ice age ended, and the communities that had grown to survive in the cold climate, were key factors in driving trials in agriculture.

By around 6,000 BC many communities were dependent upon farming. What did this mean for humanity? Mobile hunter-gatherers became sedentary communities; civilisations and innovations began to grow; status and social stratification arose from the increase in free time; but most of all our health declined rapidly.

Disease did inevitably affect hunter-gatherers for millions of years. However, the origins of major infectious diseases are thought to have only plausibly originated from the rise of agriculture. (Diamond, 1997)

Agriculture came with a trade-off: increased fertility and population growth (Page et al., 2016). Nevertheless, this benefit to growing civilisations perpetuated the spread of disease. In Polynesia, intensive agricultural islands had population densities exceeding 120 per square mile – this was a catalyst for the transmission of diseases and decline in sanitation (Diamond, 1997). Air, water and reproductive-borne diseases found humans the hotspot for transmission. Microbes that cause gastroenteritis, for example, spread from faecal contamination of food and water whilst gut rotaviruses kill lining cells, making for raw areas which can neither absorb nor retain fluids causing diarrhoea. With each gram of faeces containing 109 viruses, microbes could thrive in such settled and confined communities with poor sanitation (Crawford, 2007) – people were living amongst their waste and ill, unlike nomads. Crowd-diseases could not be sustained with the sparse and mobile bands of hunter-gatherers, and so it was only when agriculture allowed people to settle and cheat death that we see a rise in infectious disease.

Equally, the growth in the successful reproductive turnover of humans was a hotspot for diseases. Evolution selects for organisms most effective at reproducing, allowing for the fast and widespread infection of new hosts by a microbe. Hence, densely-knit, sedentary and ever-growing human populations where the prime opportunity for microbe evolution.

The reputation of zoonotic diseases have become infamous in light of the present SARS-CoV-2 outbreak, but animal to human transmission is where infectious diseases really began. Ironically, microbes behind our own epidemics are most commonly confined to humans. Yet, the infectious killers throughout human history – smallpox, flu, TB, malaria, plague, measles etc. – all evolved from diseases in animals (Diamond, 1997).

Domestication of animals meant humans were living in close proximity to their livestock, and social animals such as cattle were also confined to spread disease more readily. Cows and pigs, social animals as stated, were already plagued by epidemic diseases and so our domestication of them allowed for transmission of non-human disease to us. This is one reason why the Americas, before its 'rediscovery', had significantly fewer diseases than Eurasia and why the Inca died from Spanish germs – 80% of their large domesticable animals were hunted to extinction or died at the end of the last ice age. As a result, only five animals were domesticated (Diamond, 1997). The relationship between the prevalence of disease and number of

domesticated animals strongly suggests that pastoral agriculture played a crucial role in the rise of infectious diseases.

TABLE 11.1 Deadly Gifts from Our Animal Friends

Human Disease	*Animal with Most Closely Related Pathogen*
Measles	cattle (rinderpest)
Tuberculosis	cattle
Smallpox	cattle (cowpox) or other livestock with related pox viruses
Flu	pigs and ducks
Pertussis	pigs, dogs
Falciparum malaria	birds (chickens and ducks?)

Diamond J. (1997). Guns, Germs, and Steel: the Fates of Human Societies. Norton; New York.

Arguably, hunters had a short life-expectancy and those that fell ill could not be supported due to the mobile nature of the lifestyle (Crawford, 2007) (as the archaeology suggests, they were abandoned). As a result, there would be less time to develop susceptibility to infection and those who fell ill could not pass the disease on. This does not demonstrate that it is hard to explore the infectious disease of nomads, although it is, but rather that agriculture provided a vulnerability that meant diseases were more widespread and could be sustained.

How did agricultural diseases become our killers? The Indian population of Hispaniola was around 8 million in 1492 AD, after Columbus' arrival the population was non-existent, zero by 1535. Examples like this are found across the world – everywhere European peoples went with their infectious diseases, populations were crippled. Infectious disease arose in dense areas by means of agriculture, and killed, and they spread in dense areas not exposed to agriculture, and killed.

Disease is just one area which agriculture paved the way to in the decline in human health. There are many other aspects of crop production which led to the ills that we face today. From nutritional deficiencies causing decreased stature and robusticity (Mummert et al., 2011) to softer foods increasing malocclusion (Pinhasi et al., 2015), there is a plethora of areas of health which suffered as a result of agriculture.

Georgina Holmes

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What is the role of Big Data in Healthcare?

Om Kela investigates whether the rise in large quantities of data can be used to save lives

Big Data is data so large, fast or complex that it cannot be analysed using traditional methods. Data is analysed, usually, using statistical methods to analyse patterns on a small scale, however, the amount of data available to businesses has exponentially risen, and Big Data and data science followed in its wake. Big Data can be broken down into 3 key aspects, called the 3 V's, Volume, Velocity, and Variety. These aspects are the mainstream definition of Big Data currently

and each refers to a significant element of Big Data.

Volume refers to the size of the data sets, which much be large enough to give meaningful insights. The laws of large numbers may be applied here, a probability theory, that states, "as a sample size grows, its mean gets closer to the average of the whole population" (Chappelow, 2019). To put this in terms of Big Data, as the data set grows, the more likely that the trends and patterns that can be found by analysing are indicative of the entire population. Another aspect administrators of Big Data watch for is the Variety of data. Data can be structured, numbers, or unstructured, strings of text, and they all need to be appropriately stored or else Big Data may very quickly lose all meaning. Velocity refers to the speed at which data streams into a data set, and thus the speed at which the administrators need to be able to react and store the data in a meaningful way.

The proliferation of devices that record and transmit data has meant that the velocity of data is very quickly increasing. These devices can range from a Thermostat to, more specific to Healthcare, a fitness watch or EKG machine. If all of the data from these devices can be intelligently stored, so that all corresponding data values are held in the same place, for example, two recordings from a fitness watch and a weight machine, or that the most important data is easiest to access, the implications are huge, and the picture that Big Data can paint is extremely vivid. (SAS Institute, 2020)

The Analysis of Big Data is just as important as its acquisition. Big Data can be analysed, conventionally, in a business context to enable cost and time reductions, to evaluate the impact of products, and in the context of healthcare the most importantly, to make smart decisions. Big Data is currently used throughout the world, with one of its biggest proponents the SAS Institute generating $3.15 billion in revenue for 2015 (Martin, 2016). The market size of Big Data worldwide is forecasted to grow to 103 billion U.S dollars by 2027 (Holst, 2020)and this clearly shows how widespread and significant this technology will continue to be. The most important aspect of this, in my opinion, is that it suggests Big Data will continue to be invested in, and thus continue to evolve and improve, which is essential if it to be used in healthcare.

Big Data, when considered from an economic perspective, is an investment into technology that primarily cuts costs, directly, by saving time, or by avoiding negative situations. This, if is seen throughout an economy, can result in tremendous sustainable growth as inflation, the rate of change in the cost of living, will remain stable, but the productive capacity of an economy will rise. This is called non-inflationary growth and is the cornerstone of medium and long term growth in

an economy.

If we look at Big Data from a health perspective, a whole host of possibilities are revealed. To be clear, Big Data is already used extensively in healthcare, and I will outline these applications, however, Big Data has a huge future in making healthcare as efficient as possible in the future. Uses in Healthcare for Big Data would always be to provide better health outcomes, or to cut down the cost of treatment. By analysing a huge data set of computerised medical records, or data from sensor devices, fitness trackers and numerous more sources, the Healthcare provider can gain a vital insight into the cost effectiveness of their procedures, drugs, and staff, given any number of factors such as preexisting health conditions from Genetic profiling, or environmental conditions for atmospheric sensors. All this amounts to a very clear picture of the impacts of decisions made on the health outcomes of specific individuals; this plays into the aspect of the smart decisions enabled by Big Data analysis. (Dash, Shakyawar, Sharma, & Kaushik, 2019)

Cost management is also extremely valuable in Healthcare beyond just the monetary value. Now considering the USA with a multi-payer, non-universal healthcare system, of course, any cuts on the cost of treatment will directly affect the recipient of the healthcare, as they now pay less. For other western countries, the impacts will be just as clear, State-funded healthcare making huge savings will allow this money to be reinvested into even further improving health outcomes for the population, creating a positive feedback loop. When considered from an economic perspective, the concept of opportunity cost applies quite aptly to this situation. How efficient a decision is can be measured by the value of the next best alternative foregone. If the foregone alternative had more value than the option chosen, then the decision was not efficient. And now that Healthcare providers can better measure the opportunity cost of their decisions, they can make their procedures and operations much more efficient, saving money and improving lives.

The future of Big Data, however, in this health setting, is personalised healthcare. This would entail each person having their specific health trajectory, mapped out in real-time. The key

aspects required to make this happen would be Genetic profiling, and then the Volume of the Big Data available to Healthcare providers further increasing. Genetic profiling involves the sequencing of the human genome and once cost $100 million, in 2001, and has since then fallen to anywhere from $200 to $2000 currently, depending on the complexity of the analysis. (Wetterstrand, 2019)

A health trajectory is the pattern of health over time, also referred to a change in health status over time. One's genetic profile indicates the likelihood of developing any number of conditions. For example, those with diabetic relatives tend to be more prone to developing diabetes themselves. If all the data from one's genetic profile is collated into a health trajectory, a healthcare provider can predict, given genetic factors, what the main risks to health are and where they will arise. Big Data can play into this massively by supplementing the genetic profile. Human characteristics are said to be determined by two factors, genetics and environmental factors, "49 percent of the average variation for human diseases and traits can be attributed to genetics. Fifty-one percent, on the other hand, can be attributed to environmental factors" (Lee, 2015). Big Data plays a huge role in providing data for the environmental factors: atmospheric conditions, purchasing patterns on food, fitness

level. By adding all the data up, one can create a full personalised healthcare plan for each individual, they can accurately predict periods of high stress and allocate healthcare resources in mitigating any risk that may arise, heart problems for example, and greatly improve health outcomes. (Henly, Wyman, & Findorff, 2011)

The drawback with this level of personalised healthcare is that privacy is hugely infringed upon. Advocates of this movement indicate that all of this data is already out there and every individual willingly but unconsciously parts with the privacy of their data in return for the good or service from the supplier they are dealing with. There are laws to prevent data being misused but with such a vast and uncomprehensible array of data, it may become hard to monitor. I believe it is imperative that if this is the future of healthcare, all measures must be taken to ensure that it is as transparent as possible, using proactive legislation, otherwise Big Data has the power to spiral out of control.

Om Kela

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Your Prescription Today and Every day: Laughter

Roshni Francis investigates the effectiveness of laughter as a means of treatment

When you stub your toe against the leg of a table, what do you do? Shout out in agony? Whimper and let tears of self-pity roll down your face? Shout out a string of obscenities and hope no one hears? Well, there's something else you could do; just guffaw till it stops hurting! Just try it next time and see what happens, you may be congenially surprised with the outcome! It has been known for a long time that laughter has several positive effects and benefits on our wellbeing and over the years there has slowly been a build-up of research to back this up. Studies have shown that laughter accommodates a wealth of benefits, within physical, mental and social health.

"The human race has one really effective weapon – laughter." – Mark Twain.

It is thought that the long sequence of exhalations that goes hand in hand with laughter cause physical exhaustion of the abdominal muscles, which in turn, induces the release of endorphins. Endorphin release is usually caused by physical activity, or the sensation of touch, for example, a massage. Endorphins are a group of endogenous opioid peptides manufactured in the central nervous system that work as neurotransmitters, whilst also having a key role in the regulation of pain through their analgesic effects. The pain tolerance effect is promoted mainly by the act of laughter itself: a 2011 Oxford University study found that after watching comedic videos, people could withstand 10 per cent more pain than before watching the videos, exhibiting that laughter elevates our pain threshold, (Dunbar et al, 2011).

Research in psychoneuroimmunology has verified the hypothesis that mirthful laughter, a eustress effect may produce a wealth of benefits (Angelfire.com, 2020). Blissful emotions and hilarity trigger the discharge of neurotransmitters. These brain sourced chemicals enter the blood stream and attach to the receptors on the surface of immune cells, altering the cell's metabolic activity, thereby, increasing efficiency. The diminishing concentration of stress hormones dictated by laughter accelerates the growth of T-cells, antibodies and immunoglobins. "Your immune system is boosted by up to 40 per cent," elucidates laughter therapist Julie Whitehead. This armoured immunity can be passed through generations: in Japan, lactating mothers of 5-6 month old new-borns with allergies were examined to appreciate the influence laughter had on their breast milk. The mothers who regularly watched humorous tapes had increased melatonin in their breast milk, which subsequently reduced allergic responses from their children. (Kimata, 2007.)

Laughing deeply exercises the muscles and organs leading to increased saturation of oxygen; the heart beats faster, pushing oxygen to the poles of the body, as the 15 facial muscles, lungs, abdomen and heart are employed. This process can leave your muscles relaxed for up to 45 minutes afterwards, leaving you in a euphoric state. Laughter improves blood circulation, digestion, metabolism and elimination of toxic substances from the body. Both stroke volume and cardiac output increase, improving

cardiovascular performance. In addition, the positive feeling lingers with you even after the laughter subsides. This has been illustrated by a study in 2001; people who had experienced a heart attack were monitored. The only dissimilarity in their care was that half viewed 30 minutes of comedy a day. The final results established the comedy-watching group had less repeat heart attacks. Additionally, they obtained depressed cortisol levels, lower blood pressure, and fewer affairs of irregular heartbeat (Wellness, 2020). So when unsure of what to do, let Ricky Gervais/ Sacha Baron Cohen send you into your much-recommended daily fit of giggles. Furthermore, laughter

burns calories; Vanderbilt University researcher Maciej Buchowski totalled the number of calories depleted by laughing. His findings conclude 10-15 minutes of laughter burned 50 calories; which could be sufficient to lose 1-2 kg over the duration of a year. Although, it is not nearly as efficient as exercise, it proves a helpful alternative for sufferers of chronic pain.

Laughter not only addresses the concept of youth from the exterior, actually it extends life expectancies. After a 15-year study, Norwegian researchers reported on the relation between sense of humour and mortality among 53,556 women and men in their country. It illustrated that people with a strong sense of humour tended to outlive those who don't surrender to laughter as much. The difference was particularly exacerbated for those battling cancer. (Romundstad et al 2016)

"You don't stop laughing because you grow older. You grow older because you stop laughing." – Maurice Chevalier.

Depression, anxiety and stress deteriorate the immune system, leaving you more susceptible to infection, but by laughing, you can instantaneously dial down the release of stress-related hormones, primarily cortisol, adrenaline and dopamine, which impede smooth function of the immune system. Simultaneously the production of serotonin and endorphins in the left frontal lobe of the brain is excited, lessening effects of stress; allowing one to remove themselves from the pain/negative thoughts if only temporarily: still especially relevant during this pandemic. There is substantial evidence that reduction of laughter frequency is a symptom of depression and that an increase in the frequency of laughter is utilised as a marker of clinical improvement. Thus, its appealing features: a non-pharmacological and non-invasive, makes it an alternative treatment for trauma and depression. A study of undergraduates involved researchers disclosing participants to depression-inducing stimuli. Thereafter, they played them either humorous or non-humorous audiotapes. Subsequently, they discovered that humour reduced levels of depression more quickly and evoked recovery. (Newport Academy, 2020)

Laughter Yoga evolved by physician Madan Kataria in Mumbai, India, is centred on amplifying the benefits that complement laughter. It is an amalgamation of breathing techniques and simple manoeuvres that mimic the physical movement of laughter. Broadening this theme further, a study (Berk et al, 2008) reported that even anticipation of laughter reduced the levels of three stress hormones: cortisol, adrenaline and dopamine.

From a social perspective: laughter may indirectly increase one's social competencies, which as a result may enhance interpersonal skills. In turn, the greater levels of social support gained may promote health-enhancing benefits. Social laughter provokes augmented pro-sociality, safety and a sense of togetherness. This has played a fundamental role in the evolution of humans and modern civilisations. Laughter, through an endorphin-mediated opiate effect, provides a paramount catalyst in social bonding. A study found that people are 30 times more likely to laugh when in company than they do when they're isolated (Provine & Fischer, 2010). The highly infectious

sound of someone exploding in a fit of giggles is far more contagious than a cough or sniff (social distancing not withstanding!). A powerful method to forgive resentments, escape hatred, nurture affinities. Laughter causes the release of oxytocin – often known as the empathy hormone (Letslaugh.com.au. 2020); laughter unites people through shared feeling during trying times, invaluable, particularly whilst in lock down.

There's so much doom and gloom around us, regardless of COVID-19 and its aftermath. Before you know it, it's so easy to begin to feel a little down and out; but with some form of laughter therapy, our social, mental and physical health, all of which are interdependent, may just thank you for it. For the sake of the NHS, keep laughing!

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BAME Health Inequalities

Nazir Sirajudeen discusses the reasons why the BAME community have suffered disproportionately during the COVID-19 Pandemic

In the midst of the COVID-19 pandemic, one particularly harrowing statistic was revealed; that those from a BAME background were twice as likely to pass away from the disease than those of a white British ethnicity. When viewing the probability of death of COVID-19 patients by individual ethnicities, Black males are twice as likely to succumb to the disease than their white British counterparts whilst for black females, this number is 1.4. Furthermore, people of Indian, Bangladeshi, Pakistani, Mixed and Other ethnicities "also had statistically significantly raised rates of death involving COVID-19 compared with those of White ethnic background." (Office for National Statistics, 2020). Clearly, this raises the question of why exactly the rate of death from COVID-19 is higher for those of a BAME background. Why is it that individuals from a BAME background are more likely to report poorer general health than the white British population? (Evandrou, et al., 2016).

One argument that gives reasons for the poorer health of BAME, and indeed for having a higher death rate for COVID-19, is socioeconomics. Those from a BAME background are "overrepresented in poor, overcrowded accommodation, or households with multiple generations under one roof." (Khan, 2020) as well as being more likely to live in poverty. These factors certainly play a part in the BAME population having poorer health, with a greater prevalence of underlying health conditions such as diabetes and asthma, as well as a lower than average life expectancy. This can give reasons for the increased death rate of COVID-19 among the BAME population. Anil Gumber, a Senior Health Economist as Sheffield Hallam University, wrote, "A lack of money and time to devote to maintaining a healthy lifestyle combined with lower levels of health literacy often results in BAME people having weaker immune systems than more affluent groups". With the death rate of COVID-19 being four times higher for those suffering from diabetes, this would explain the predisposition of BAME patients being more likely die from the virus.

However, the ONS figure of black men and women being 2 and 1.4 times more likely to pass away from COVID-19 than their white counterparts had been adjusted for their socioeconomic background. For all other BAME ethnic groups, apart from Chinese and Mixed-race females, the risk of dying from COVID-19, after adjusting for various factors including "region, population density, area deprivation, household composition, socio-economic position, highest qualification held, household tenure, multigenerational household flags and occupation indicators" (Office for National Statistics, 2020), is greater. Evidently, there must be other factors at play here.

One of these factors that could further give an explanation as to why there are health inequalities amongst the BAME population is that they report a "poorer healthcare experience than white British persons" (Evandrou, et al., 2016). The reasons given in the BMJ published article states examples of language barriers, poorer knowledge about services and lack of accessible information as reasons for the worse experience suffered by the BAME group. Furthermore, a report from the King's Fund had stated "*those responding to the survey from Pakistani, Indian and Bangladeshi backgrounds reported significantly poorer experiences (as hospital inpatients) than White British or Irish respondents, particularly on questions of prompt access, as well as their experience of involvement and choice" (King's Fund, 2006)*. Even more alarming was that the same report states that there were glimpses of some serious lapses in services which have led to fatalities. Although this report was published in 2006, many of the problems highlighted are still persistent to this day.

Another point that could be attributed to the health inequalities faced by the BAME population, and one that links to the points made throughout this article, is due to racism and discrimination. This was directly stated in a recent British Medical Journal (BMJ) article with the headline reading, 'Racism may be linked to ethnic minorities' risk" (Iacobucci, 2020) with regards to COVID-19. The previous paragraph had already highlighted some of the issues of racism in a healthcare setting, namely the poorer experience that ethnic minorities face. Furthermore, there is an under-representation of ethnic minorities in medical research. This is especially problematic as one article states *"This often-inadvertent exclusion has serious implications for medical science by limiting validity and generalisability and for social justice by affecting the allocation of resources for services and research." (Redwood & Gill, 2013)*. Moreover, if medicine is to become increasingly reliant on Artificial Intelligence for the treatment of patients using medical research, then this would result in further health inequalities for ethnic minorities.

The racism experienced within the NHS is not just limited to the BAME patients. During the outbreak of COVID-19, as of the 5th June 2020, 60% of the NHS staff who were killed by COVID-19 were BAME. This is despite only "20.7%" of NHS staff being from a (non-white) ethnic background. (NHS Workforce Statistics, 2019). In a BMJ article that tackles with racism present within the NHS, one investigation, by Zosia Kmietowicz, found that *"medical schools are poor at recording students' complaints of racial harassment" (Adebowale & Rao, 2020)*. Instead of speaking out against the discrimination they have faced, the article goes on to state that the students instead 'internalise the humiliation' and accept this type of harassment must be common in a career within the NHS. In addition, this racism can also damage career prospects of minority ethnics. It was found in 1993 that *"doctors with English names were twice as likely to be shortlisted for senior*

house officer jobs as those with Asian names, despite having the same experience and training." (Iacobucci, 2020). Yet new data referred in the article suggests that the discrimination of BAME doctors for speciality training posts still persists to this day. This poses an important question; if the NHS discriminates against its own staff, how can BAME completely trust the organisation to be treated free of discrimination?

Evidently, there is a lot of improvement and structural changes required in order to elicit positive changes to combat the discrimination in the healthcare industry. As outlined previously, increasing the access to healthcare for BAME patients can allow for better outcomes and a better healthcare experience. Examples of ways to improve the experience could be to use culturally appropriate and sensitive programs for treatment, bilingual staff and community-based services that seek to educate BAME in a culturally sensitive method (British Dietetic Association, 2018). Additionally, with regards to rooting out the discrimination against NHS staff, this problem must be addressed with encouraging students to speak out and complain about the racial harassments they face whilst training. This could allow for a better mindset for when they join workforce and be less likely to 'internalise the humiliation' referred to earlier. Also, allowing BAME staff to have discussions with senior managers about their experiences as well making sure that the proportion of BAME staff in very senior positions is similar to the proportion of BAME staff within the NHS can allow for better understanding of the impact of racism within the NHS. Whilst these changes may not completely eradicate the problems faced by BAME in the healthcare setting, it would at least address and actively try to better the situation faced by 8.1 million people within the UK.

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Psychedelics- A Wonder Cure?

John Stockton discusses whether Psychedelics can be used for treating mental illnesses and whether its illegalisation is unfair

On November 16, 1939, the world saw one of the first synthesised psychedelics, Lysergic Acid Diethylamide or LSD for short. It was synthesised by Albert Hofmann, a Swiss chemist based at a pharmaceutical company called Sandoz. In 1943 'Bicycle Day' was founded when Hofmann came into contact with his synthesised LSD and accidentally started to perceive its effects as he started to see a "kaleidoscope" of colours and "fantastic images surged" on him. (Tayag, 2017). Soon after Hofmann commenced his lifelong work and passion on psychedelics and commenced supplying universities with LSD and also Psilocybin, commonly found in mushrooms. Academics like Timothy Leary, once a psychologist from Harvard, would then experiment with their therapeutic effects in 1960 and test their effects on curing mental illness. (Kabil, 2016)

Psilocybin, another psychedelic, has said to have been in use early as 9000 B.C. By indigenous tribes and cultures around North Africa. After this as many might know the, Aztecs used hallucinogens greatly in their culture. Calling it *Teonanácatl,* meaning "flesh of the gods". Many believe this could've been psilocybin in mushrooms or peyote, a small spineless cactus with psychedelic effects.

The True Start of Human Testing

One of the early tests with Psychedelics was by Eric Kast. Through practical research he found out LSD had a 'analgesic' effect comparable to some other drugs, yet the LSD's analgesia carried on even after the somewhat intense and memorable psychedelic effects that most recognise the drug for. Patients also seemed to be more psychologically in tune, acting happier and better human around their family and friends. Through emotional testing also, the general consensus was that most of the people who had been tested on were much happier. (Kast, 1964).

Another test done, by two un-named researchers showed a 27-year-old male suffering from body dysmorphic disorder and would stare at himself in the mirror for hours on end every day. After being treated with psilocybin mushrooms it was reported his disorder improved and he when looking in the mirror he would not see himself as deformed anymore. (Hanes, 1996)

In NYU, 29 patients suffering from depression due to having been diagnosed with cancer. Patients were ever given 250mg of niacin, a placebo, or 0.3 mg/kg of psilocybin. The results showed that the psilocybin alleviated the anxiety and negative thoughts of death from the patients as they called there experience 'mystical', making them seem wiser and happier. (Nichols, 2016).

To a few, tests like these could be seen as misleading with many thinking putting patients under the influence of these drugs and under an induced state is neither ethical nor humane. Giving patients a false sense of hope about not only death, but how they perceive life and how others perceive them. As if making them live a lie. I'd say this is wrong as for everyone life is how you perceive it, nothing more or less. If these patients start to perceive life in a different light, this is not misleading but eye-opening for the patient and also the people around them. Happiness is just a delusion of life, so inducing that delusion is not cruel but instead the complete opposite.

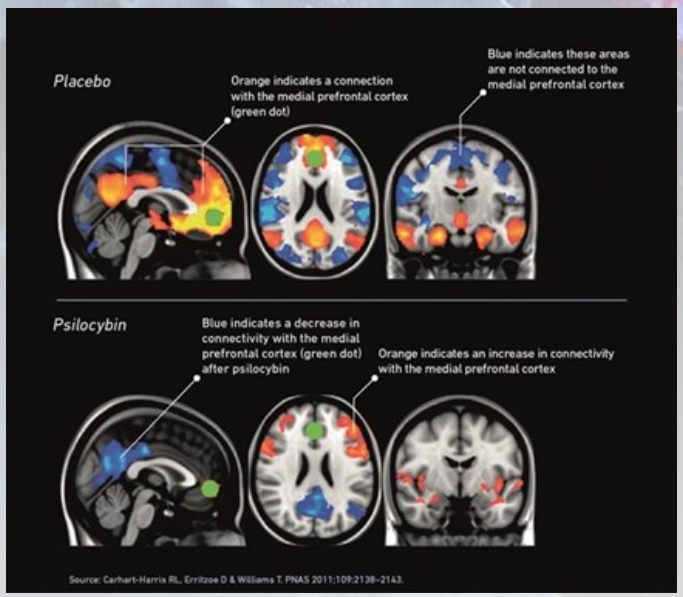
Detailed tests and research on how psychedelics can cure addiction and the much needed science behind these tests.

Matthew Johnson, an associate professor of psychiatry and behavioural sciences at Johns Hopkins, a research centre at the University of Baltimore, conducted an amazing test on how pure psilocybin can try help cure nicotine addiction.

The test started with 15 patients. The patients with an average of smoking 19 cigarettes a day for 31 days were enrolled many having tried to quit prior to the experiment. The patients were given therapeutic sessions called Cognitive Behavioural Therapy. They were also given psilocybin in weeks 5,7 and optionally 13. After taking the psilocybin and being told that each day was there last day of smoking, they were research by the team all day. (Lawerence, 2014)

After a six month follow up, it was reported that 80% (12 of the 15) had stopped smoking completely. This was ground-breaking due to the typical results for

addiction therapy to be around less than 35%. During a follow up, Johnson and his team suggested that the abstinence to the smoking was due to the patients 'mystical experience' rather than the intensity of the drug itself. (Johnson, 2014)



The science behind this research experiment is quite remarkable and could be seen as one of the main points behind the legalisation of psychedelics, due to the remarkable and wonderous capabilities. Using a functional MRI, it can be seen that psilocybin and many other psychedelics stimulate the Serotonin 2A receptors found in the cortex of the brain. This stimulation then causes a decrease in activity in an area of the brain called the default mode network. The default mode network (DMN) is responsible for our thought patterns and behaviours embedded in our nature. When a person is going through addiction the DMN is overwhelmed by negative thoughts and cravings. Thus, when the DMN is less active it relaxes the patient and allows them to escape all these thoughts and cravings which can be destructive and dangerous in the case of smoking. After the test, one of the patients reported that "It became non-important, like who care?" when talking about tobacco cigarettes. Showing signs of a detachment to the addiction due to decreased activity at the DMN presumably. (Lawerence, 2014)

Overcoming Regulations

Enacted by the 91st US Congress and taken into effect around 1971, the controlled substances act caused psychedelic research to be driven out of the US and as other countries followed the world started to see a close on psychedelic research and testing. Signed in by Nixon, Psychedelics were deemed more harmful then useful and research banned. Maybe due to the mass use of psychedelics like LSD and peyote being mass used by society recreationally. This act was controlled by the DEA and forced pharmaceutical companies like Sandoz to take the psychedelic testing to other countries and try and see what other uses were to be found and utilized.

After this only more regulations came with the CSA as psychedelics were seen 'highly abusable' and there was 'little safety' when regulating such drugs. (J.Belouin, 2018)

However, in the early 1990's when the American government started the rebirth of human studies with psychedelics. This was due to a few different factors such as animal testing had been thorough, but researchers still need human testing if they could carry on their work. Social and political attitudes also changed as the world progressed and not only society but the FDA (Food and Drug Administration) and NIDA (National Institute on Drug Abuse) started to question the look over of psychedelics and started to change a few things since Nixon's war on drugs and thus from the 90's psychedelics were legal for human studies. (Williams, 1999).

From then on, many research projects started, many sparked from influence of Timothy Leary and Hofmann's Research pasts which brought them unchallenged fame in the world of psychedelics and psychotherapy.

The future of aiding psychedelics

With the creation of Multidisciplinary Association for Psychedelic Studies (MAPS) by Rick Doblin, originally started as a response to the illegalisation of MDMA, and many more companies and research laps like MAPS. The future of Psychedelics is most promising with many 'psychedelic-assisted therapies' to be approved not only in the US but internationally. Many new research projects such as curing opioid addictions with ibogaine, a natural psychedelic found in iboga plants and commonly used by Shaman, which would be ground-breaking as unlike psychedelics. Opioids are undoubtedly addictive and cause many deaths and ruined lives.

Something specifically MAPS are trying to overcome is that psychedelic tests are reluctantly insured due to their negative stigma. This would also cause problems

for patients who need the drug for a research project or even a prescription. (Haridy, 2019)

Personal thoughts and conclusions

Psychedelics do have medicinal uses, and this is a fact. There are many research projects and tests which prove that in some way or other psychedelics can help many. This does not mean they are for everyone though as it can be easily seen from common knowledge. Referred to as a 'bad trip'. Many have not experienced the mystical effects of these drugs and instead a more detrimental approach to their mind but rarely their physical health. I feel going forward into the future that for research purposes should be highly regulated just like any other drugs. Background checks should be thoroughly done into the patients before testing the drug. These projects should be treated with the safety precautions of most drug trials and that is with the utter most care. Once this is achieved, I feel, like many others, that psychedelics could be the key to a whole new world of medicine particularly in mental health and wellbeing and hopefully some negative stigma is cleared up about research into psychedelics.

John Stockton

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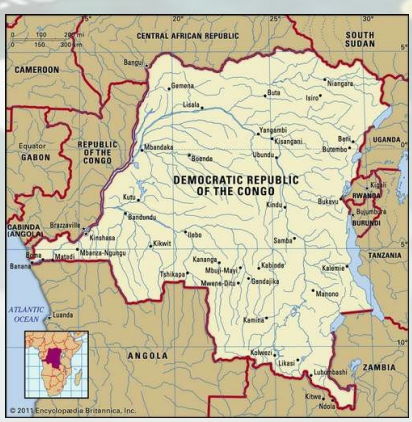
Coltan, Congo, Conflict – The 'Blood' in the Mobile Phone

Nicholas Njopa-Kaba and Tejas Easwar looks at the connection between your mobile phone and the human rights abuses in Africa

Coltan is the ore that provides the key metal tantalum which is used in many electronic devices such as mobile phones, DVD players, video game systems and computers. The name coltan is derived from the minerals it contains: columbite and tantalite, which contain the elements niobium (also known as columbium) and tantalum respectively. Much of the Coltan we use is obtained from the Democratic Republic of Congo (DRC). DRC is located in central Africa (the second largest country in the continent) and is rich with resources (including diamonds, cobalt and copper).



However, the mining of Coltan in the DRC is controversial, with ethical, social, political and financial dimensions which include forced child labour, drug cartels and environmental issues. In the past 15 years, 5 million people have died as a consequence of civil war in DRC, with the UN reporting links between the minerals trade and the war. Is it really true that our phones are financing a war in the Congo? If the world has known about this why hasn't anyone done anything?

The Use of Tantalum in Electronics

Tantalum is extracted from the Tantalite mineral found in Coltan ore. Although it isn't anywhere near as well recognised as elements like Silicon, in the field of electronics, Tantalum is an extremely important element. This is because it is an excellent material for making capacitors. Capacitors play key roles in a wide range of circuits commonly used in electronic devices, but what do they actually do?

Coltan Ore

Capacitors separate charge and store electrical energy, using an electrical field. They consist of two oppositely charged plates separated by an insulator. This insulator is called a dielectric and can be anything from a layer of air, to paper. Importantly, the choice of dielectric can make an enormous difference to the capacitance of the capacitor, or the charge stored per unit potential difference across it.

For a parallel plate capacitor, the capacitance is defined as:

$$C = \frac{\varepsilon_0 A}{d}$$

Where C is the capacitance, ε_0 is the permittivity of the material, A is the area over which the plates overlap and d is the distance between plates.

From this equation we can see that to increase the capacitance of a capacitor we should decrease the distance between the two plates and have a dielectric with a high permittivity. This is where Tantalum excels.

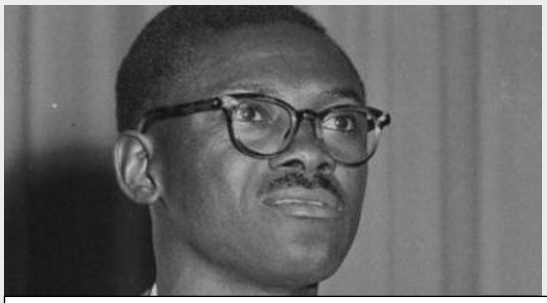
Tantalum forms an oxide layer (Ta_2O_5) which has a relatively high permittivity, which is used as the dielectric in Tantalum capacitors. This layer is created in an electrolytic bath and the thickness of this layer depends on the voltage applied. Tantalum forms a very thin oxide layer per volt applied

(1.7nm/V) and as a consequence, Tantalum capacitors can achieve high capacitances in a smaller volume. With the desire for electronics to constantly shrink, the value of making smaller and smaller components is huge.

In addition to this, Tantalum has a high melting point of 3017^{o}C and is exceptionally resistant to corrosion, in part due to the oxide layer that is forms upon contact with the air. All of these properties mean that Tantalum has numerous medical applications as well. Tantalum capacitors are both durable and reliable making them very biocompatible allowing for electrical implants such as implantable hearing aids, insulin pumps and implantable cardioverter defibrillators (ICD's).

The History of the DRC; how mobile phones may have started a war

- **1870s** - Belgian colonisation; King Leopold II sets about colonizing the area as his private holding
- **1908** - Congo Free State placed under Belgian rule following outrage over treatment of Congolese. Millions of Congolese are said to have been killed or worked to death during Leopold's control
- **1960** - Independence, followed by civil war and temporary fragmentation of country



Patrice Lumumba was independent Congo's first prime minister. He was murdered, allegedly with US and Belgian help

In July, Congolese army mutinies; Moise Tshombe declares Katanga independent; Belgian troops sent in ostensibly to protect Belgian citizens and mining interests; UN Security Council votes to send in troops to help establish order, but the troops are not allowed to intervene in internal affairs. UN troops begin disa

- **1965** - Mobutu Sese Seko seizes power

Mobutu Sese Seko renamed Congo as Zaire and looted the country during his three decades in power

- **1997** - Rebels oust Mobutu, reinstating the original name, Democratic Republic of Congo. Laurent Kabila becomes president
- **1997-2003** - Civil war, drawing in several neighbouring countries (Africa's first world war).
- **2006** - Presidential elections and parliamentary polls are held—the first free elections in four decades, with Joseph Kabila declared as winner
- **2011** - Kabila is re-elected in elections. But the vote is criticised abroad and the opposition disputes the result, starting a period of turmoil
- **2013** - the UN Intervention Brigade is deployed to fight and disarm rebels in east
- **2017** - the DRC is facing crisis, forcing 1.7 million people to flee their homes

High levels of corruption lead to political instability because whoever controls the assets, can use them for their own benefit. The profits made from the mining of Coltan helped fund such political groups, accelerating and prolonging the conflict. Such serious conflict include the Ituri conflict and the Second Congo War. As the world more heavily relied on Coltan in electronics, armies and leaders (especially in eastern Congo) converted mines into slave labour regimes to finance their militia. A 2003 UN Security Council report stated that much of the ore is mined illegally and smuggled across the Congo's eastern borders by militias from the neighbouring Uganda. A UN panel studied the eastern Congo for months before releasing a remarkably sharp condemnation of the ongoing military occupation of eastern Congo by Ugandan, Rwandan, and other foreign military forces, as well as the many bands of Congolese rebels fighting with one another. The UN report accused the fighters of massively looting

Congolese natural resources, and said that the war persisted because the fighters were enriching themselves by mining and smuggling out coltan, timber, gold, and diamonds. However, for the Congolese people, mining is a steady and reliable source of income, even if only for a dollar a day and the laborious work.

The UN report (2001) stated this: "Here lies the vicious circle of war. Coltan has permitted the Rwandan army to sustain its presence in the Democratic Republic of Congo. The army has provided protection and security to the individuals and companies extracting the mineral. These have made money which is shared with the army, which in turn continues to provide the enabling environment to continue the exploitation."

The Environmental impacts of Coltan

Uncontrolled mining in the DRC has caused soil erosion and polluted lakes and rivers. As a result of all of this, the biodiversity and ecosystem in the DRC has shrunk. Furthermore, many miners have few food sources and thus rely on wild meat (bushmeat) to sustain themselves. It is believed that this has caused the eastern mountain gorilla's population to diminish - at the moment, this species is critically endangered in the DRC.

To conclude, the negative ramifications of using of Coltan are clear. Our phones are financing a civil war that is destroying countless human and animal lives in Congo. A global effort is required to reduce the requirement of Coltan in the electronics industry. Many phone companies, including Nokia and Apple, are already addressing the problem and have found potential alternatives and solutions. It is imperative that more companies follow suit.

Nicholas Njopa-Kaba and Tejas Easwar

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The UK Government COVID-19 Policies

Tejas Easwar discusses whether it was wise to use scientific evidence and mathematic modelling as a basis for policy

This current Covid-19 pandemic highlights the complex intricacies and interactions between science, policies and politics. The marked policy U-turns to manage this pandemic raises questions over the quality of scientific evidence used to guide the UK government. The government has repeatedly stated that it is being 'led by science' on a wide range of decisions such as closing schools, introducing lockdown, restricting air travel, use of isolation techniques and now the prospect of lifting lockdown. However, scientific views on such topics may be unclear and differ depending on the background of the scientific advisors. Ultimately, even amongst scientists, much is still unknown about this virus. Therefore providing clear public guidance is inevitably difficult. Invariably then, politics comes into play to decide policies and guidance. As Covid-19 ravaged East Asia, the UK government was confident that they were 'well-prepared'. However, now with the figure at 34,636 deaths (as of 17/05/20), some people are beginning to ask where did this all go wrong?

Some key figures are beginning to say that the UK government's advice has been confusing, conflicting, contradictory and not internally consistent within the different nations of the union. On 10th May, the First minister of Scotland stated that "Boris Johnson's vague 'Stay Alert' slogan would cost lives in Scotland". The UK opposition leader stated that different approaches across the four nations to tackle coronavirus are not going to "help us out of this crisis". Matt Lucas' viral video parodied the Prime Minister's speech: "So we are saying don't go to work, go to work, don't take public transport, go to work, don't go to work… And we will or won't, something or other". This emphasizes the widespread public confusion. Furthermore, Teaching Unions, backed by the British Medical Association have raised concerns about the safety of both teachers and pupils restarting school on June 1st. Despite this, the government has insisted that English schools are "safe".

On 30th January, the World Health Organisation (WHO) declared Covid-19 as a public health emergency of international concern, urging governments to prepare for its global spread. Studies suggested that there may be higher death rates and a need for more ventilators. These remarks should have sent alarm bells ringing. However, the UK government had a mix-up over the EU ventilator scheme and missed the deadline to get extra ventilators for this crisis. All these initial warning signs were ignored. It could be argued that the UK government was forewarned, but this did not translate in being forearmed.

On 3rd March, the UK government published its 4 stage approach to tackle Covid-19: contain, delay, research and mitigate. By 11th March, Italy had taken aggressive public action by implementing a full lockdown (swiftly followed by Spain and France). Meanwhile the UK's Scientific Advisory Group (SAGE) rejected a lockdown, believing that the population would not follow it. On 12th March, the UK moved from 'contain' to the 'delay' phase of the action plan. Along with this change, was the government's abandoning of crucial 'contact tracing'. The chief medical officer explained that it was no longer necessary to identify each individual with the disease and that all testing would be diverted to hospital patients. The UK government had turned its back on the WHO standard containment approach of 'test, trace, isolate'. This approach had been so successful in many countries including South Korea and Germany. Despite many viral tests being available and offers of help from university and private labs, the government had no future plans for further testing and contact tracing. The PM warned that families were going to "lose their loved ones before their time", though taking little action to suppress the spread of the virus. Perhaps the underreporting of figures in China, led to complacency in action.

Increasingly, evidence-based policies are beginning to shift to the opposite, policy-based evidence. Political choices are being made with science advice systems subsequently backing them up. BBC's Panorama investigation, exposed shortages of personal

protective equipment (PPE) among healthcare workers. In January, the government assigned Covid-19 as a 'high-consequence infectious disease'. The Health Safety Executive (the government agency enforcing workplace health and safety) advised certain PPE required to tackle Covid-19. However, on 19th March, the government downgraded Covid-19 from level 4 (the highest threat level) to level 3, despite it being one of the most highly consequential diseases of the century. This enabled the government to provide a lower standard of PPE to health workers. Particularly of note is that the new list lacked essential gowns, visors and respirator face masks, which were left out of the government stockpile setup in 2009 – potentially as a result of austerity measures. There were many UK factories willing to make this PPE for the government, which could have replaced this loss. But, the government did not respond to these businesses, leading to this essential equipment being shipped abroad to other countries. It was later revealed that the official reason for downgrading the disease was due to a 'lab-test' showing that the Covid-19 mortality rates were lower overall than expected. However, this is by no means certain. It seems policy makers are cherry-picking evidence and modelling that best suits their own agendas. The sad truth is that the cost-cutting measures on PPE has resulted in many healthcare workers losing their lives prematurely because the government has not been adhering to its own previous scientific guidance. Meanwhile in many countries wearing face masks in public has become standard practice. Worries that the NHS may be overloaded (and hospital beds full) has resulted in many elderly patients being prematurely discharged to care homes. In the absence of testing, this high risk measures enabled the spread of Covid-19 to the vulnerable in care homes, leading to a second wave of infections.

Whilst many countries had stopped social gatherings, closed schools and advised people to stay at home, the UK government initially rejected the idea. The virus was initially considered to be mild for most, like Influenza A. Consequently, the government's strategy initially depended on 'herd immunity' since this had been effective against Influenza. Herd immunity describes the point in a population where there is sufficient immunity that the infection will not spread within the group. Thus, immunity in the herd will protect the most vulnerable. However, with Covid-19, herd immunity is more challenging as a preventative measure for two main reasons. Firstly, there is some evidence from the Korean Centres for Disease Control and Prevention (and now more recently Italy and France) that some people who had previously recovered testing negative, being re-infected by the virus. Although such studies need further testing, it seems immunity to Covid-19 may not be as effective as the common cold. The WHO warns that as few as 2 -3% have developed antibodies in the blood to Covid-19. The report blows any hopes of herd immunity as a solution to this pandemic. Secondly, for herd immunity to work, at least 70% of the entire population need to be infected. This virus would appear to be more lethal than the Influenza, leading to higher fatalities. Best guesstimates suggest that infection rates cannot be more than 15%, due to the high deaths. Therefore reaching the 70% required for herd immunity is unattainable.

Subsequent modelling by Imperial College estimated that 250,000 people may die in this scenario. However, if social distancing measures were implemented, the number of deaths could be limited to 20,000. The results of this study caused a dramatic policy U-turn. The result being that schools were closed, social distancing measures implemented and a lockdown introduced. The government was wise to follow the models and this policy change likely saved countless lives and flattened the curve. Nevertheless, flirting with the idea of herd immunity for so long at the start of the epidemic would have impacted the spread of the disease. It does beg the question – did the government really use scientific evidence as a base for herd immunity? Rather, the three pillars of public health should have been employed right from the start: test, trace, isolate.

At the core of the UK government's response to Covid -19 has been a number of scientific advisory groups. Two key groups are the Scientific Advisory Group (SAGE) and the Scientific Pandemic Influenza Group on Modelling (SPI-M). SAGE and SPI-M predominantly consist of mathematical modellers and epidemiologists. Neither group had public health experts (key in advising during a pandemic), nor experts in communicable diseases. Whilst scientific and mathematical modelling are important to advice the government, it requires collaboration of other fields as well (including public health experts). The

Guardian stated that the PM was absent at several of these important strategy meetings. Instead, the PM's political advisors attended on his behalf raising doubts of political bias within the group.

The UK government's response may not have been a flop as many critics make out. Although the government has perhaps been slow off the mark, they have quickly recovered, imposing lockdown and restrictions when necessary. The lockdown was indeed effective at flattening the curve. The R0 (the infection rate - assessing the average number of people that one infected person will pass on the virus to) has significantly dropped from between 3 and 4.6 before lockdown, to now between 0.75 and 1. By any measures, this will be considered a success. The PM's televised speech on 10th May showed much more regard to scientific evidence and modelling. As the UK slowly comes out of lockdown, it is essential that the government continues to pay attention to such data. There is still a lot of unknowns and scientific understanding continues to evolve. It has been challenging to find a vaccine. The above measures will work best only when a vaccine is found. No country can continue to remain in lockdown as the economic implications will be disastrous. Students miss education, workers lose jobs, productivity declines and countries will go into recession if lockdown continues. Such draconian measures should be restricted to the minimum. In the face of such unknowns, the government may have been wise to conserve its reserves, to sustain itself through a long, difficult period. Recently in South Korea, as the population began to return to normal life, there have been increases in the number of Covid-19 cases, sparking fears of a second wave of infection. If a similar resurgence was to happen in the UK, it is vital that the government is well-prepared and resourced. Perhaps the government's initial inactivity may have been tactical.

In summation, the government has been wise to use scientific evidence and mathematical modelling. Perhaps paying even more attention to these sources could have resulted in further benefits. Policy makers should refrain from cherry picking certain pieces of evidence to support their decisions. Rather, they should approach policies with a balanced view and consider different viewpoints. Perhaps a more collaborative approach between scientists, mathematicians, public health experts and policy makers could have made better use of existing evidence when approaching key decisions. Although this pandemic has emphasised the greater need for 'evidence based policy making', we are far from understanding the true nature of this virus. Scientific and mathematical evidence must also be complemented with sound, aggressive political reasoning based on logic and past experiences. Despite efforts, finding a vaccine is proving to be elusive, hampering public health interventions. Most of evidence so far has been based on previous pandemics, and as such may not hold true with this current crisis. It may be that the UK government has adopted a course of masterly inactivity, in order to conserve resources to deal with future unknowns. Whether or not this is the case, only time will tell.

Tejas Easwar

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A New Era of Spaceflight for the USA

Annabelle Onions discusses the recent Crew Dragon Demo-2 mission

In 2014, a SpaceX Dragon Capsule was launched to resupply the International Space Station (ISS). It contained a set of legs (which belonged to a robotic astronaut). Now in 2020, the company have gone one step further and launched 2 complete human beings into space creating one of the most historic launches in history.

The End of the Shuttle Programme

The Space Shuttle was NASA's first ever reusable spacecraft and was a vehicle that was launched as other rockets but returned to Earth in a plane-like style. Throughout NASA's Shuttle Programme 3 craft were operated, each of these designed to fly up to 100 times. However, when the programme closed these had only flown 23, 33 and 39 times respectively. So what caused the end of this programme leaving America unable to get into space without reliance on Russia?

For many years the shuttle dominated NASA's budget and never met the low cost aims that it was expected to. With this as incentive, in 2004 President Bush announced that the programme would be shut down in 2010 as part of his 'Vision for Space Exploration' in order to fund further projects such as the Crew Exploration Vehicle which later became the Orion project. When Barak Obama came into office in 2009, the shuttle gained an extra year of operation leading to it's close in 2011 as America waved goodbye to independent spaceflight for a considerable amount of time.

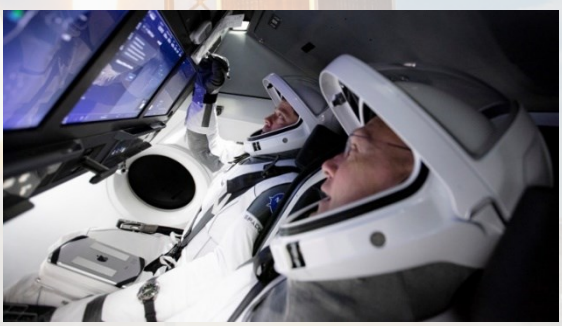
NASA-Space Shuttle

NASA's New Business Plan

With the Shuttle Programme out of action, NASA had no way to launch their own manned missions and had to pay Russia to do so for them with Soyuz crafts. From 2011 onwards, the space industry in America received little funding from congress causing NASA to look at other ways to get people into space without having to develop their own capsules and rockets.

The solution came with private space companies which NASA was able to invest in as a result of increased budget in recent years. One of these was Boeing and another was SpaceX both of whom have been working on launch systems for the huge space company. Over 6 billion pounds later, on the 30th May, Musk's company delivered.

Take Off



NASA- Inside Cockpit of Crew Dragon

With reliable astronauts Robert Behnken and Douglas Hurley sat in the cockpit (who between them had a 4 missions worth of experience), Crew Dragon was ready for it's Demo-2 mission on the 30th May. This would be the first launch of astronauts from American soil in nearly 10 years and SpaceX's first fully crewed craft to reach orbit. Despite the restrictions of the coronavirus (Mission control had to be reorganised so that all desks were 2m apart) the Falcon 9 rocket with the crew capsule on top was successfully launched at 20.22 (BST). 2 and a half minutes later, the first stage had separated and was on it's way back down to land perfectly upright on a boat in the middle of the ocean. Another 4 minutes after this and the 2 astronauts had made it into orbit, a huge success for the team back on Earth.

Whilst travelling to the ISS, Behnken and Hurley spent a large amount of time testing parts of Crew Dragon as well as doing manual flying and tests via the touchscreen control panel. After a 19 hour journey, Crew Dragon autonomously docked in the ISS thanks to GPS, cameras and imaging sensors all of which help to make the capsule the most modern out there.

SpaceX- Crew Dragon on top of a Falcon 9 (launch)

A Sentimental Journey

One of the first jobs of the astronauts when they made it into orbit was to name the spacecraft they were travelling in. Behnken and Hurley jointly decide on the name 'Endeavour', not only because it highlighted the enormous feat that had been achieved but also because it meant something quite personal to both of them. The two had both been a part of the shuttle programme and had their first flights on the Shuttle 'Endeavour'. For them the name was a nod to where they had come from and Crew Dragon's predecessor.

This was not the only part of the voyage that linked to the Space Shuttle's reign. On the final flight of the shuttle programme in 2011, the commander of the mission, Chris Ferguson (a man who is currently working on the Boeing equivalent of Crew Dragon), took up a US flag which had gone into orbit on the very first shuttle flight in 1981. He attached this flag to the docking hatch of the ISS for the next Americans to bring back home as crew mate Doug Hurley watched on. Now, as commander of the Crew Dragon flight, Hurley can stow the flag and bring it back home.

SpaceX- Class of 2020 mosaic

The final sentimental element of the flight is one that connected many students to this voyage. NASA and SpaceX called for any students graduating in the year 2020 to send in their photo to make up part of a huge collage that would be sent into space with the astronauts. This is particularly touching given that many are missing their graduation ceremonies this year due to the pandemic.

What Goes Up Must Come Down

NASA/Cory Huston- Recovery test of Crew Dragon

At the time of writing, there has been no clarification of exactly how long Doug Hurley and Robert Behnken will spend on the ISS. It could be anywhere between 1 to 4 months that the two will be helping the Expedition 63 Crew who are already there to carry out experiments and perform further tests on the transportation system. For example, all emergency procedures must be checked so that they aren't being performed for the first time should disaster strike. Whenever they are given the go ahead to come back to Earth though, the Dragon Capsule will be ready. The capsule will undock and jettison it's trunk section before it's 6 hour descent to Earth. Elon Musk has said that 'the return is more dangerous than the ascent' but the company remain confident in the craft and it's planned splashdown off Florida's Atlantic Coast.

Into the Future

Should the rest of the Demo-2 mission be successful (as it is very likely to be) NASA are ready to sign a $2.6 billion contract with SpaceX to fly 6 fully operational crew missions to the ISS, the first of which is planned to launch on the 30th August 2020. The Crew Dragon recovery will be the final step in allowing America long duration missions to the ISS of their own accord without having to rely on Russia.

This launch also really opens the doors for NASA's Artemis programme as it is likely that they will buy in rockets and capsules as part of their plan to get the next man and first woman on the moon by 2024. Development for landers with this programme has already begun with NASA paying a total of $967 million to Blue Origin, Dynetics and SpaceX all of whom are looking to develop lunar landers for the company.

The first development will probably be that of Boeing who have been working on a capsule and launch system to carry astronauts into space as well as SpaceX. Due to problems with parachutes and emergency escape systems, this project is slightly behind SpaceX but many expect that the CST-100 Starliner will launch to the ISS in 2021 or 2022 with Chris Ferguson as it's commander.

Boeing- Artist's impression of the CST-100 Starliner

An Incredible Achievement and the Start of Commercialised Spaceflight

The launch of Crew Dragon on a Falcon 9 rocket was a huge moment in history for America and one which has changed the space industry for good. It seems that spaceflight is no longer led by government organisations and is now a business. SpaceX has become the first private company to launch a rocket for a national agency and many are eager to follow. The age of boosters, blasts and big spenders is upon us.

Annabelle Onions

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The Force of Gravity

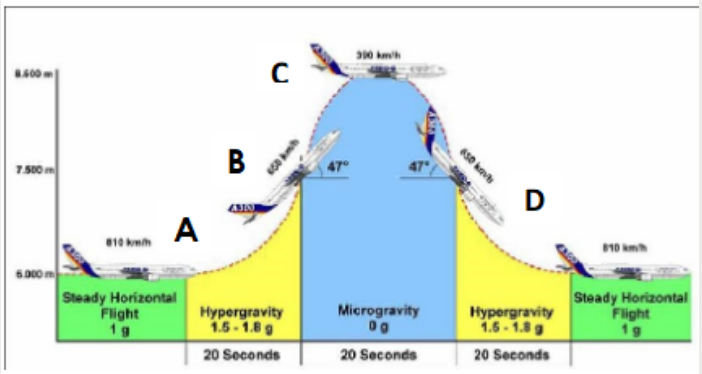
Sarah Beadle's simple guide to the vomit comet, Neutral Buoyancy training and detecting dinosaurs

On Earth every person is acted on by the same force: gravity. But is it possible to manipulate the value of which this acts? Can we feel weightless on Earth?

A common misconception is that a zero gravity chamber could be constructed- this will remain a part of the science fiction universe! Neither NASA nor other such science institutes are home to these mythical chambers, instead astronauts undergoing training will experience simulations of the feelings of weightlessness or take to the sky to undergo micro-gravity training.

Reduced gravity aircraft

A Reduced-gravity aircraft is the most effective way to provide weightlessness in order to train astronauts and conduct experiments in an almost zero-gravity environment, and with good reason it is notoriously known as the vomit comet.



This diagram models the flight of an Airbus A310 Zero-G which undergoes 'parabolic arcs' in order to reach a point of micro- gravity. This particular aircraft is predominantly utilized for experimentation purposes. The plane -which is used by the ESA- can be used to test the effects of materials or organisms in micro-gravity or possibly a hyper-gravity environment. Experiments may be trialled here before being sent to the ISS.

Another zero-g aircraft to be aware of is Novespace's 'Zero-G' A300 Airbus the largest aircraft ever used for parabolic flight. (145 tonnes) (ESA, Unknown)

A-Once flying level at a height of around 6000m the aircraft is ready to begin its 'weightless manoeuvre', climbing at a 45-50˚ angle with full engine thrust.

Passengers will experience a period called 'hyper-gravity' the value for gravity ($1g=9.81m/s^2$) effectively adds to that of the acceleration of the engines therefore making the value between 1.5g to 1.8g.

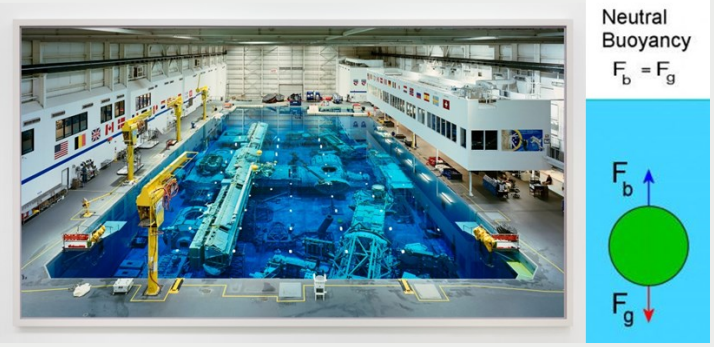
B-20 seconds later - once the plane has reached a height of approximately 7600m - the pilots 'throttle down' the engines almost to zero thus reducing the power output in order to compensate for air resistance. From this point the plane reaches a period of 'micro-gravity' -a point of almost weightlessness- as a consequence of all forces cancelling each other out.

The plane is now in free fall.

C-The plane reaches the apex of the arc at approximately 8500m, the remaining momentum of the aircraft carries it to this point.

D-The plane descends experiencing once again hyper-gravity, and then may ascend up another parabolic arc.

Simulating Zero-G



This is the Neutral Buoyancy Lab, a NASA facility located in Houston, Texas. The NBL specialises in training for EVAs (Extra vehicular activities). Rather than creating weightlessness the NBL is an attempt for closely imitating the feel for training astronauts.

Training astronauts are made neutrally buoyant through a combination of weights and flotation equipment.

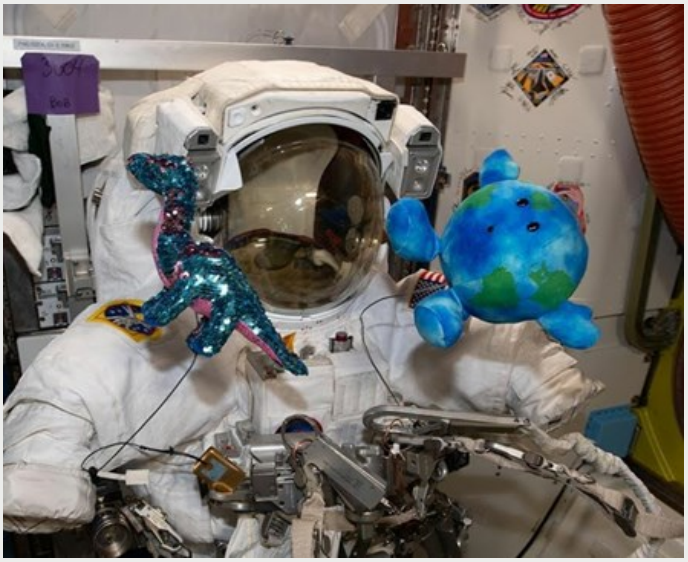
Neutral Buoyancy- A point at which the weight of the fluid displaced by an object is equal to the weight of the object. (Archimedes Principle).

Up-thrust=weight

This training method does not provide an exact feeling of weightlessness but a similar feeling that allows trainee astronauts to undergo EVA preparation with replica of sections of the ISS.

The lab contains an astonishing 6.2 million gallons of water. (NASA, 2006)

To any staff or students who wish to experience Zero-G, tickets on-board a weightlessness experience aircraft can be bought for $5000 or alternatively, you could book the entire plane for $165,000 (Corporation, 2017)- so perhaps it might be more cost effective to experiment with floats to create neutral buoyancy at your local pool!



Sarah Beadle

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How do touchscreens work?

Tom Onions investigates exactly how touchscreens work in the phones we use every day

When the first iPhone was released in 2007, it was a radical idea to incorporate a screen which the user could touch and receive a response from. Nowadays, a touchscreen is taken for standard on most advanced technology devices, to the point that the tech community is slightly disappointed if a new piece of tech does not incorporate some sort of touchscreen. There are two main types of touchscreen that are used in modern society, the resistive touchscreen – which, as the name implies, offers resistance against the user and is one that has to physically move in order to recognise the touch. This is often found in products that need to be very durable and are used by lots of people such as in ATMs and . The other type of touchscreen is found in most mobile phones, and tablets and is called a capacitive touch screen. This relies on the capacitance of the human body to edit the electrical field to register touches.

The resistive touchscreen works on a fairly simple premise – you push down the screen, and it records the position in which the material was pushed down. The mechanism is a bit more complicated, but a lot simpler and cheaper than the capacitive touch screen. There are two main layers before the screen within the resistive touchscreen, the flexible layer – often some sort of plastic and the stronger layer at the back, in which the touches are recorded on – usually glass. These layers are coated with indium tin oxide – a conductor, which allows the electricity to pass through the layers. Indium tin oxide is transparent, so this is often used in touchscreens (both the resistive and capacitive), so the information on the screen below can be seen through the touchscreen. There is actually a small gap between the two layers in the resistive touchscreen, as when the layers are together, the screen registers a touch, and so they must be kept apart to prevent, 'phantom touches'. The screens are kept apart by small spheres called spacers, which are placed at regular intervals providing enough pressure to make sure the screen only touches the glass when it is pressed. When the screen is pushed down, and the two layers meet, the voltage that was running through the both of the screens interacts and changes the current. This change is then interpreted by a small processor, which locates the x (horizontal) and y (vertical) coordinates of the position where the current changed. This passes the location onto the CPU, which in turn identifies what should be done to process the user's request. Due to the nature of the resistive touchscreen, it cannot process multiple touches to the screen so is not able to process actions that the capacitive touchscreen can, such as zooming with two fingers and using multi finger gestures. Another disadvantage is that, due to the layer of air between the screens, there are a lot of reflections, which means it is harder for the user to see the screen, especially outside. However, the touchscreen is able to be used with gloves and styluses as well as being more durable than the capacitive touch screen.

There are three main sections to the capacitive touchscreen – a layer of glass, the touchscreen, and the display (which is where the image is projected

onto). The glass used in most modern phones is toughened, by soaking it in potassium nitrate – which makes many of the sodium atoms in the glass move out, and lots of the much bigger potassium atoms to move into the glass. As the potassium atoms are a lot bigger than those of the sodium but have taken up the same space, they produce force pushing outwards towards the surface of the glass. Because there is less room for the atoms to move about, it makes the glass a lot stronger, and less susceptible to damage and scratches – as the compressed atoms take a lot more force to break. Underneath the layer of toughened glass, there is the touchscreen, which is where your finger is registered when you tap your device. It is made up of two grids either side of an insulator, which prevents the electrical charges interfering with each other. These two grids are in turn made up of very small diamonds and made out of the transparent Indium Tin Oxide (which is a conductor). Electrons are built up on the lower grid which are unable to move, due to the presence of the insulator between the grids, but instead create a negative electrical field which is able to surpass the insulator, causing positive charge to build up on the upper surface, creating a capacitor. Because your finger has a natural capacitance (it can conduct electricity and store charge), as you touch the screen, it makes the positive electrical charges change positions and are attracted to where your finger is. The phone's CPU actively scans the columns of the upper grid and the rows of the upper grid for changes in current or voltage. At each point that the columns and rows cross, a point is created, and it is at these points that the computer will, 'touch the screen'. This in turn means that the more points that a computer has (the closer together the columns and rows of the grids are), the more accurate the touchscreen will be. This information is passed onto the processor, and because the grid is scanned multiple times a second, it allows the processor to detect different patterns of touch input, such as swipe and touching the screen in different ways. This is what allows you to zoom and switch between apps with simple gestures. However, the capacitive touch screen relies on the capacity of the body, so if gloves cannot be used with this type of touch screen.

The final part in both screens is the display, which is where the actual information is displayed. In most modern phones this uses Organic Light Emitting Diodes (OLED). This is a grid of pixels which can have different amounts of red, green and blue, which can generate any colour. For example, if there is the same amount of red, green and blue being generated, then it will produce a white colour in that pixel. Increased amounts of each colour in the same quantity increase the brightness of the colour. Modern day smartphones have millions of pixels, each of which can display any colour, which allows them to produce very high-quality images that are seen on your phone. It is necessary for all of the layers of electronics before the screen to be transparent, so that you can clearly see the display below.

Tom Onions

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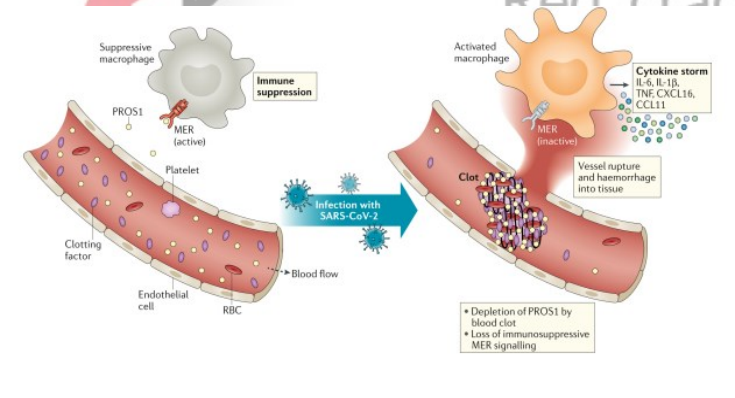
Kawasaki Disease during the COVID-19 Pandemic

Jatin Naidu discusses the Kawasaki Disease associated Multi System Cytokine Storm in children during the COVID-19 Pandemic

Kawasaki Disease (KS) is a rare condition which affects 8 in every 100,000 children, mostly those under the age of 5. Its characteristic clinical manifestations include a rash, swollen glands in the neck, dry/cracked lips, red fingers/toes and red eyes. As of late April 1 2020, NHS doctors were told to look out for a rare but dangerous immune reaction in children, possibly linked to COVID-19. Riphagen et al., studied the clinical presentations of children (n=8) suffering from this hyperinflammatory shock and found they were very similar to those arising from KS with unrelenting fever (38-40°C), peripheral oedema and generalised extremity pain with gastrointestinal problems. However, following a study in the Journal of the American Medical Association, it was established that the condition was, in fact, new and distinct from KS and has now been termed Paediatric Multi-system Inflammatory Syndrome (PMIS). The illness is severe and disproportionately affects black children, although outcomes are favourable with intensive hospital care.

Two-forms of PMIS have been spotted. One that centres on viral sepsis- a severe inflammatory response to an infection that causes depressed heart function and low blood pressure. The other variety emerges weeks after COVID-19 infection or exposure, with some more classic Kawasaki symptoms as listed above, including changes in the shape of the heart's arteries.



The exact pathophysiological mechanism for this new phenomenon is unknown. The syndrome has similarities to the abnormal immune response caused by Kawasaki disease (KD), macrophage activation syndrome (MAS), and cytokine release syndrome. This is backed up by studies showing upregulation in acute phase pro-inflammatory markers, namely, ESR, C-reactive protein, or procalcitonin- very similar to KS.

The excess leaking of cytokines into the bloodstream seems to play a part in the massive inflammation that weakens blood vessels. This may explain why pre-existing cardiovascular disease correlates with severe COVID-19. Hundreds of micro-clots that form in the bloodstream have also been reported to collect in the lungs and clog dialysis machines used to treat kidney disorders. It's not clear why this happens- however, the complement immune system could have a role to play. The complement immune system involves inactive proteins that circulate in the blood. In other disorders, inappropriate activation of this pathway can manifest in the formation of tiny clots. This may explain why blood clots form in PMIS. However, a multifactorial process may also be responsible for this.

PMIS is a pressing issue that needs to be addressed; currently, with active investigations underway investigating the mechanisms of the exaggerated immune response- the outcomes of which will be welcomed by many.

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