

The background of the entire image is an aerial photograph of a coastline. The top half shows the ocean with white, frothy waves crashing over a dark, rocky shore. The bottom half shows a similar view of turbulent, white-capped waves. In the center, a horizontal band of sky and distant land is visible, with a large, rounded rock formation (likely a sea stack) prominent in the middle. The text "LET'S TALK SCIENCE" is superimposed on this central band in large, bold, black capital letters.

LET'S TALK SCIENCE

29-05-2020

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CLINICAL TRIALS AND GENDER BIAS – AN IMPINGE ON WOMEN'S HEALTH

Is there a lack of clinical trials relating to women's health? Unfortunately, the answer seems to be 'yes'. There is no dispute that most medical research has been done on male biology, be it humans or animals, mostly by male doctors and scientists, leaving women with a healthcare system that according to Dr. Kate Young from Monash University has been "made by men for men".

According to a research study published in July 2019 by the Allen Institute of Artificial Intelligence, which looked at the participation of women in medical research over 25 years with 43000 research studies and 13000 clinical trials, across conditions like hepatitis, HIV/AIDS, chronic kidney diseases, digestive diseases and cardiovascular disease (often called the "man's disease" even though it is the number one killer of women) showed a much lower percentage of female participants in comparison to the percentage of real-world patients. Worse, a pilot study from Rockefeller University, supported by the National Institutes of Health (NIH), about how obesity affects breast and uterine cancer didn't enlist any women at all. In some cases, the numbers are miniscule: the alcohol safety test of a female viagra drug called "Addyi" was done on 23 men and 2 premenopausal women.

Operating under the general assumption and misconception in early research studies that men and women were the same, the treatments used for men were administered to women as well. One of the first studies to disprove this assumption was a Women's Health Study titled "A Randomized Trial of Low-Dose Aspirin in the Primary Prevention of Cardiovascular Disease in Women" published in 2005 which showed that the effect of aspirin on women as prevention of heart failure was not the same as men.



The 10 year-long study showed that women taking aspirin every other day were just as likely to suffer from a heart attack as women who were taking placebos. The drug did, however, prevent the risk of a stroke in women, an outcome that was not seen in men. Even though more women in the U.S. have been included in medical trials since the 1990s, due to the FDA and NIH's policies, there is still bias when it comes to the results. While, women may now be included in the trials as a result of these guidelines, researchers have not always analysed their results.

This underrepresentation of women is leading to improper treatment and drug discovery. In 1938, a drug to prevent miscarriages in women was found to have harmful effects on the daughters of the roughly 400,000 women on the drug, 30 years later. In 2018, a research paper titled "Cancer immunotherapy efficacy and patients' sex: a systematic review and meta-analysis" showed how after the analysis of multiple databases for randomised controlled trials of immune checkpoint inhibitors that cancer immunotherapy is much more beneficial for men and men's survival rate from spontaneous cancer.

With women being underrepresented in clinical trials, the understanding of women's health has been limited resulting in women being provided with ineffective treatment and medication. We also need a greater study of women health if we want to understand how diseases present themselves differently in women. For example, women show unique symptoms when it comes to a stroke than men. Women often report symptoms such as nausea, fatigue, hiccups, and seizures when having a stroke; symptoms that are very different from the ones in men. Due to this difference in symptoms between men and women, it often takes a longer amount of time to realize that the woman is suffering from a stroke. Further, sexually transmitted diseases, presented differently in men and women with women less likely to have symptoms of common STDs as compared to men.



If we want to improve health outcomes for women, we not only need a better understanding of how diseases present themselves, but also how treatments work in their bodies. We must change the protocols around research studies and clinical trials and pay more attention to how women describe their conditions and reactions to treatment – this requires both empathy and an acceptance that women's bodies function differently.



- ATUFA SHABNUM

*"If working
with only one
sex or gender,
then specify
that, and
explain why."*

The Gender Gaps

in scientific research & scientific publishing

THE LANCET

"The Lancet encourages researchers to plan to analyse data by sex, not only when known to be scientifically appropriate, but also as a matter of routine."

Sex bias in trials and treatment must end

Gender inequalities in biomedical research are undermining patient care. In the first of three related pieces, **Alison M. Kim, Candace M. Tingen and Teresa K. Woodruff** call on journals, funding agencies and researchers to give women parity with men, in studies and in the clinic.

NATURE VOL 465 10 JULY 2012

www.nature.com/nature

Vol 465 | Issue no. 7299 | 10 Ju

Putting gender on the agenda

EMBO reports VOL 13 | NO 7 | 2012

Biomedical research continues to use many more male subjects than females in both animal studies and human clinical trials. The unintended effect is to short-change women's health care.

COMMENTARY

Open Access

Gender-sensitive reporting in medical research

Heidari et al. *Journal of the International AIDS Society* 2012

<http://www.jiasociety.org/content/15/1/11>

Nature's sexism

The editors of this publication need to improve how we reflect women's contributions to science. For this, we must inject an extra loop into our thinking.

nature

Cell sex matters

1 AUGUST 2013 | VOL 500 | NATURE | 23

Male and female cells can behave differently — it is time that researchers, journals and funders

set priorities.

MIND THE GENDER GAP

Despite improvements, female scientists continue to face discrimination, unequal pay and funding disparities.

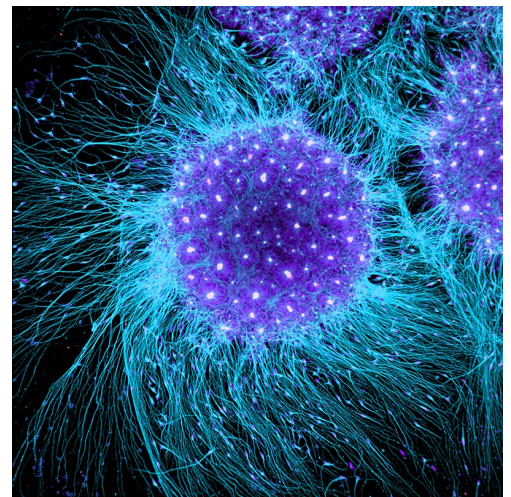
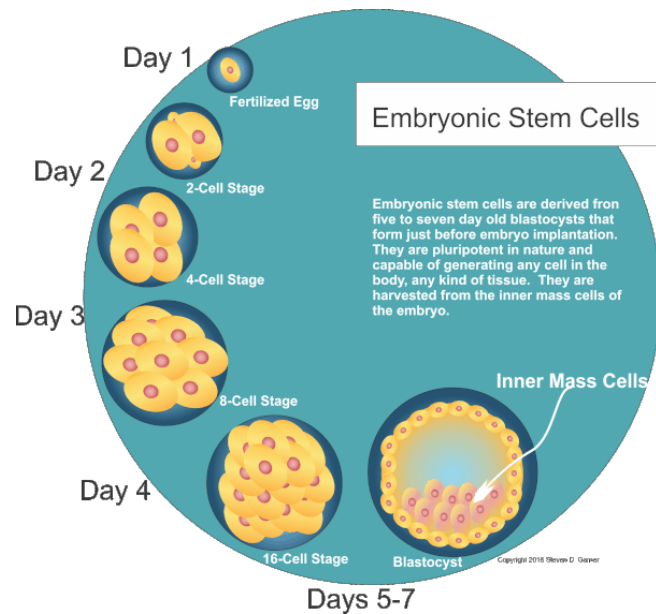
EDITOR: NATURE | VOL 500 | 1 AUGUST 2013



STEM CELLS — A MIRACLE OR AN ETHICAL HAZARD

Biological science has been at constant progress and with such progress comes to a result that is stem cells. Stem cells provide new cells for the body as it grows and replace specialized cells that are damaged or lost. They can divide repeatedly to produce new cells. As they divide, they can variate into other types of cells that make up the body. These qualities have proved stem cells to be of great help for biological development and human welfare. But the real concerns surface when many scientists argue that the methods of harvesting stem cells lack morality and humane values. These wondrous life-saving cells are of 2 varying kinds. First adult stem cells can be extracted from various parts of the human body. This method has low-risk factors because the cells are derived from the host itself and there is a low chance of complication. But this is a very complicated procedure that involves a crucial combination of skill innovation and technology. The second type is embryonic stem cells in which stem cells are harvested from the embryo. Although this method is the most effective in producing stem cells for human welfare, this method puts the embryo in fatal danger. This is what scientists argue about being morally and ethically lacking. Although many say that such methods can be used on animals to benefit the species of homo-sapiens, it has been argued by different activists that this cannot be done since it is not viable based on morality.

This is where the real question arises - if what we decide to do is to be ethically and morally correct or not. Looking at the rising number of disease caused by permanently damaged cells it is just a matter of time when we humans ignore all morality grounds and begin fulfilling our merciless desires which has been evident throughout history.



-VIKRAM ANAND THAKUR

HOW COVID-19 IS AFFECTING OUR MENTAL HEALTH

COVID-19, an infectious disease caused by a newly discovered coronavirus, has caused to havoc across the globe. Due to this pandemic, most countries have taken drastic measures to restrain the spread of this disease such as implementing a complete lockdown where citizens are not allowed to go out of their homes unless it is absolutely necessary. This means that lots of people have to spend most of their times living in confined spaces of their homes. Now if you're an introvert this is probably good news, you won't have to engage in human contact much. However unlike introverts, extroverts, who are used to and enjoy their own company, are taking a huge hit.

Most extroverts are used to constantly being around human contact, and human contact keeps them happy and engaged and satisfied. However not being with people gives us time to think. And thinking too much can lead to overthinking, which can lead to anxiety and stress when there are no actual things happening in the real world, but just made up scenarios in their head. Studies show that an average human spends 2-3 hours each day texting/calling their friends and families during this lockdown.

Being in touch with humans helps reduce anxiety and stress and keeping yourself busy will stop a person from overthinking and feeling stress and anxiety. But not only that, studies show that an average person sleeps 3-4 hours more than they normally would in this lockdown. The reason for sleeping extra could be the body's natural way of avoiding hours awake in which those hours, human contact is necessary. However due to limited human contact, sleeping is our body's natural way off avoiding stress, anxiety and overthinking.



Industries which have benefitted from this pandemic, are the online streaming industries, where studies show that websites like Netflix, Hulu and Amazon Prime have seen an increase of 20% in daily users. TV shows and movies are a great way for a person who is alone in lockdown, to kill time and avoid overthinking, stress and anxiety. Due to our minds being in a relaxed state as humans don't have to focus much while watching, all our problems seem to disappear, and a sense of enjoyment can be felt.

However due to this feel of relaxation, prolonged hours of show/movies are being watched by users in this lockdown. Eventually the temporary excitement from "binging" goes away. I ask you this question, have you realized and understood that you are wasting time watching your favorite show while you have other work to finish but still continue to "binge" while being stressed at the same time. That is known as addiction, and chances of having that during this lockdown is very high. Such activities could be a reason why studies also show that during this lockdown an average American has a 14% chance of suffering from depression, which is a 4% increase pre-lockdown.

Another industry which has seen a huge influx in daily users as a result from this lockdown is the gaming industry. The gaming industry had already existed way before the online streaming industry but had fallen due to many people switching from gaming to "binging" as sites like Netflix had more content appealing to a larger audience. However, due to this lockdown and people "binging", and feeling as if they have accomplished nothing from watching shows/movies, this is where the gaming industry kicks in.

Due to games being interactive and mostly user-controlled, there is a sense of accomplishment when completing a game rather than completing a movie. This can be due to the fact that simply while gaming there is some effort going in and requires focus. The gamer is rewarded with completion of the game leaving them with satisfaction and happiness. This happiness is supported by the fact that the gamer had to "work" for it. But it did not seem like "work" for the gamer as he/she enjoyed putting his/her effort in and completing the game.



Gaming is a really great way to keep your mind off things, and to stay calm and relaxed and is usually a pretty great distraction for people suffering from anxiety, stress and depression while staying at home. However, prolonged hours of gaming can eventually lead back to depression, stress and anxiety as once getting back to your real life, and doing real-life chores will make you realize how there has been no sense of accomplishment, and the happiness was temporary and virtual.



So how can we avoid from getting stressed, overthinking, anxious and depressed? Well the simple answer would be to keep a balance of everything. Play games, watch movies, but also work. Set a schedule. Majority of the people feel lost as they feel like they don't have a sense of purpose. So firstly set a timetable, set fixed timings of texting/calling friends and spending time with loved ones, work hours, gaming, tv shows/movies, exercise and other feel good things that are good for your health. And once you have a schedule, you won't feel disorganized and lost and will have a happy and fun lockdown.

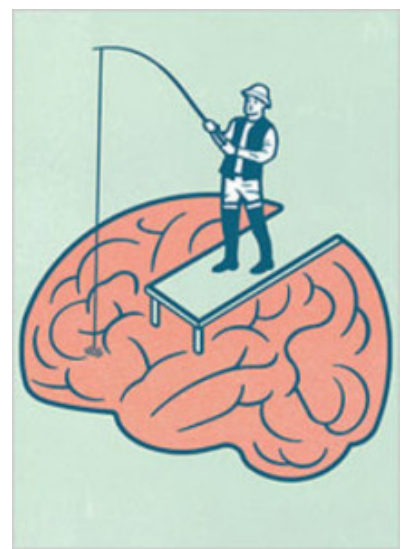
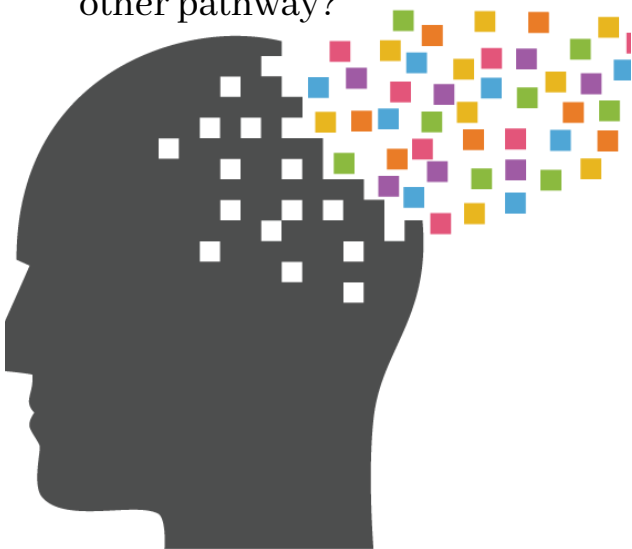


-ABDULLAH ABIDI

MEMORY RECALL

'Memories are timeless treasures of the heart'. This quote rings true in most of our lives. Our memories not only hold important knowledge about our lives and our personalities; through mental time travel, episodic memory can also directly transport us into the past, to the person we were, and into the future, to the person, we are yet to become. But, I have wondered, how can this small brain of ours hold so many "treasures", surely we would forget some along the way. Yet, time and again, the brain has held onto those precious moments, reminding us of them when we need them. However, how they are recalled is another process altogether.

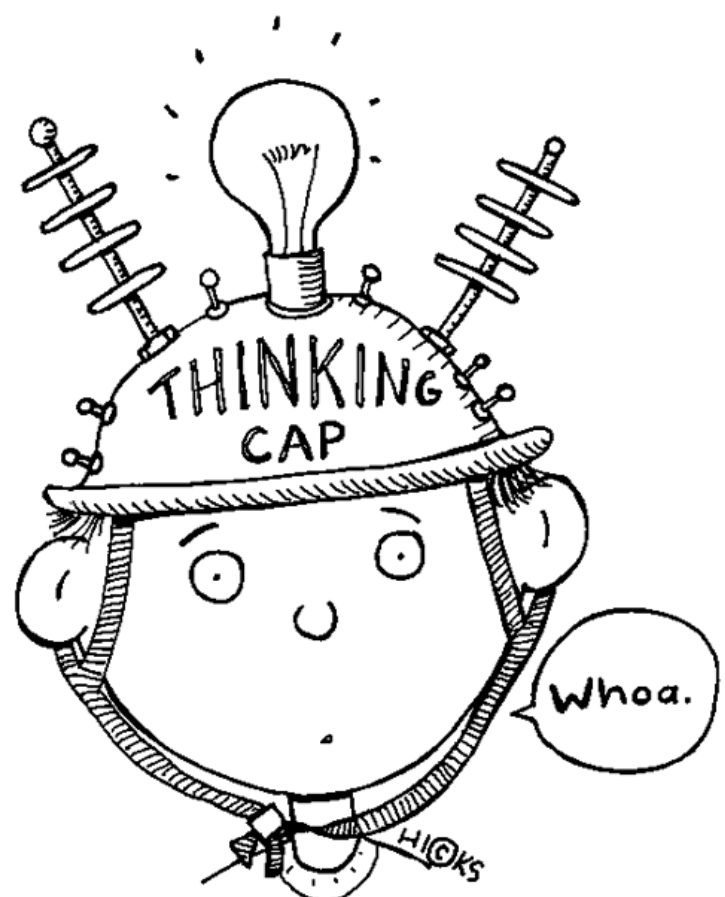
Memories are stored in a manner that involves different elements stored in disparate parts of the brain linked together by associations and neural networks. Memory retrieval, therefore, requires re-visiting the nerve pathways the brain formed when encoding the memory and the strength of those pathways determines how quickly we recall the memory. Recall effectively returns a memory from long-term storage to short-term or working memory in a kind of mirror image of the encoding process. It is then re-stored back in long-term memory, thus re-consolidating and strengthening it. However, the question here is what allows a specific nerve pathway to be reactivated over any other pathway?



The answer is Synaptic Plasticity. This term describes the persistent changes in the strength of connections – called synapses – between brain cells. These connections can be made stronger or weaker depending on when and how often they have been activated in the past. Active connections tend to get stronger, whereas those that are not used get weaker and can eventually disappear entirely.

Changing the strength of existing synapses, or even adding new ones or removing old ones, is important to memory formation. Nevertheless, there is also evidence that another type of plasticity, not directly involving synapses, could be important for memory formation. In some parts of the adult brain, such as the important memory structure known as the hippocampus, brand new neurons are created in a process called neurogenesis. Studies in older mice have shown that by increasing neurogenesis in the hippocampus, memory can be improved. In humans, exercise has shown to increase the volume of the hippocampus – suggesting the creation of new neurons – and at the same time improve performance in memory tasks.

-ARSHIA G SARAH

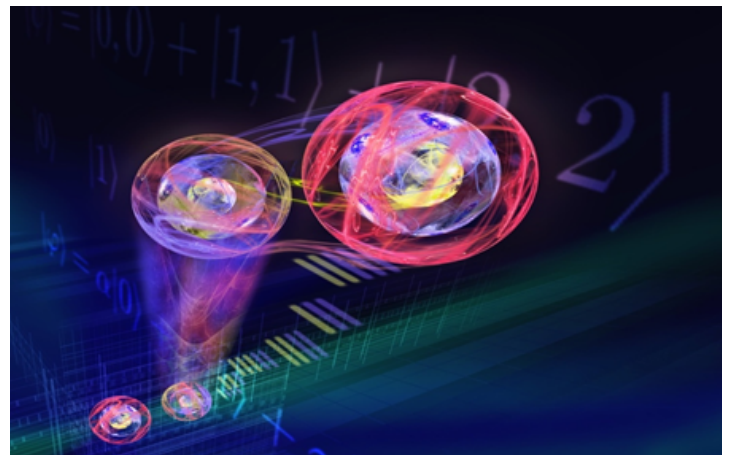


TELEPORTATION

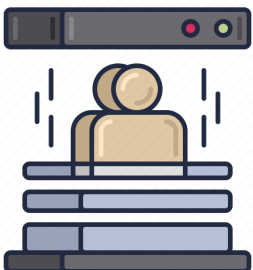
SCIENCE OR FICTION?

Have you ever watched a sci-fi movie and wondered how heroes use their technology to travel to an alien planet light years away in a second while it takes you 1 hour to reach your school that's 25 km away from your house? Imagine living in a world where instead of a 12-hour flight, it would take you fractions of seconds to travel to a country on the other side of the globe, and waking on the moon would actually be a one small step for man. Yes, I'm talking about teleportation. But the question is, "Is teleportation just a piece of fiction or does it really exist in the realm of science?"

And the bigger question is, "Is it possible to teleport human beings?". The short answer is, teleportation does exist but it's not the same as Kirk saying, "Beam me up, Scotty" (Star Trek).



Teleportation hasn't been strictly sci-fi since 1993. That year, the concept moved from the realm of impossible fancy to theoretical reality. Physicist Charles Bennett and a team of IBM researchers confirmed that quantum teleportation was possible, but only if the original object being teleported was destroyed. Why? The act of scanning disrupts the original such that the copy becomes the only surviving original. In 1998, physicists at the California Institute of Technology (Caltech), along with two European groups, made IBM's teleportation theory a reality by successfully teleporting a photon -- a particle of energy that carries light. The team read the atomic structure of a photon, sent this information across 3.28 feet (about 1 meter) of coaxial cable and created a replica of the photon on the other side.



teleportation



As predicted, the original photon no longer existed once the replica appeared. The main problem with the teleportation of things bigger than a photon is the Heisenberg Uncertainty Principle. The Caltech team used a phenomenon called quantum entanglement to not violate this principle. The uncertainty principle states that you cannot simultaneously know the location and the momentum of a particle. It's also the main barrier for teleportation of objects larger than a photon. Since then, much larger photon teleportation distances have been achieved.

When a journalist asked physicist Asher Peres if quantum teleportation could transport a person's soul as well as their body, the scientist replied: "No, not the body, just the soul."

So, quantum teleportation might be a huge leap for making super-fast and efficient computers with high speed data transfer but sadly your commute time isn't changing.

Even if we ignore the Heisenberg Uncertainty Principle, for a person to travel to another location instantly, his/her information has to be transferred at the speed of light which is a big no-no according to Einstein's theory of relativity. Also, a human is made up of 10^{28} atoms, which is more than a trillion atoms. The teleporter machine would have to identify and analyze all these atoms and replicate the exact information and even the slightest of mistake could lead to a severe damage in the teleported body. Even if advancements in science help us overcome all these obstacles, human teleportation would be a process where the original body dies, and a new clone is generated at a different location but will have the same physical traits, memories and emotions. It would basically include murdering and cloning and last time I checked they are both criminal offenses. But hey, think of all the time you'd save!

-ABHINAV GUPTA



CHILD AGGRESSION THROUGH OBSERVATION

The Bobo Doll Experiment

Albert Bandura was a professor of Psychology at Stanford University, very well known for his Social Learning Theory. The Social Learning Theory of Bandura emphasizes the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others. Now, what does this theory have to do with the Bobo Doll experiment?

The Bobo Doll experiment is a well-known experiment conducted by Albert Bandura in 1961. Bandura conducted this experiment with his colleagues to examine one possible way children learn aggression.

The participants of the experiment were from the Stanford Nursery school including 36 girls and 36 boys, with the age ranging from 3-6 years old. The experiment was divided into three categories, exposure to aggressive adult models, exposure to non-aggressive adult models, and no exposure to adult models. There were a total of eight experimental groups, out of which one group (24 participants) had no exposure to adult models. The second group had exposure to aggressive adult models and the last group had exposure to non-aggressive adult models.

These groups were further divided into boys and girls which had subgroups of same-sex adult models and opposite-sex adult models.

Each child was tested individually. For the group with the aggressive adult models, the child would be in the same room as the adult but far apart in different corners. The adult model would violently attack the bobo doll repeatedly while the child observed. The models were instructed to be violent with the doll in a certain way, like beat its nose, sit on it, etc. The adult models were also instructed to use verbal phrases like kick him, punch him, etc. For the group with the non-aggressive adult models, the adult would ignore the bobo doll and just play with the toys laid out.



The children were allowed to observe the models for 10 minutes and then later taken to another room filled with appealing toys of their age. They were allowed to play with them for two minutes and then later were told to stop playing to ignite the aggression in them. They were taken to the last experimental room which had aggressive toys like guns, mallet, and the bobo doll.

Results of the experiment;

After the experiment, the recorded results show that children with exposure to non-aggressive adult models and no exposure to adult models were less aggressive than children exposed to aggressive adult models. Children who were exposed to aggression imitated the same actions and phrases as the adult male models. Although it was seen that boys with opposite sex aggressive adult models were less aggressive than the same-sex aggressive adult models. It was also seen that girls imitated the verbal phrases more and the boys imitated the actions more.

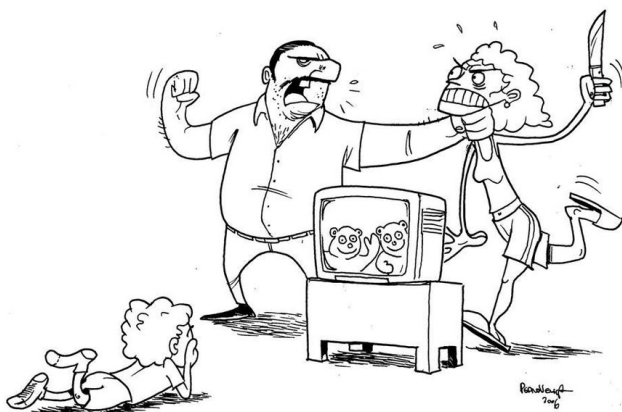
What does this have to do with Social Learning Theory?

The experiment is a clear example of observing and modeling behaviors.

Children being exposed to violent acts, movies, and shows, etc, influences their aggression towards life. At such a young age they imitate and learn from their surroundings. But Albert Bandura also acknowledges the fact that children can be influenced by positive acts as well.

Children are more sensitive and naiver towards life than grown adults. It's human nature to learn from others. Observation of surroundings reflects on our lives and decisions. Social learning theory is quite important and a major part of a child's life growing up. A child must have a nurturing, attentive, and a positive environment to grow in. It reflects on the person they grow into. Like Dorothy Notte once said:

'Children do what they learn what they live. Then they grow up to live what they've learned.'



Some annalists believe that TV is turning the kids more violent.



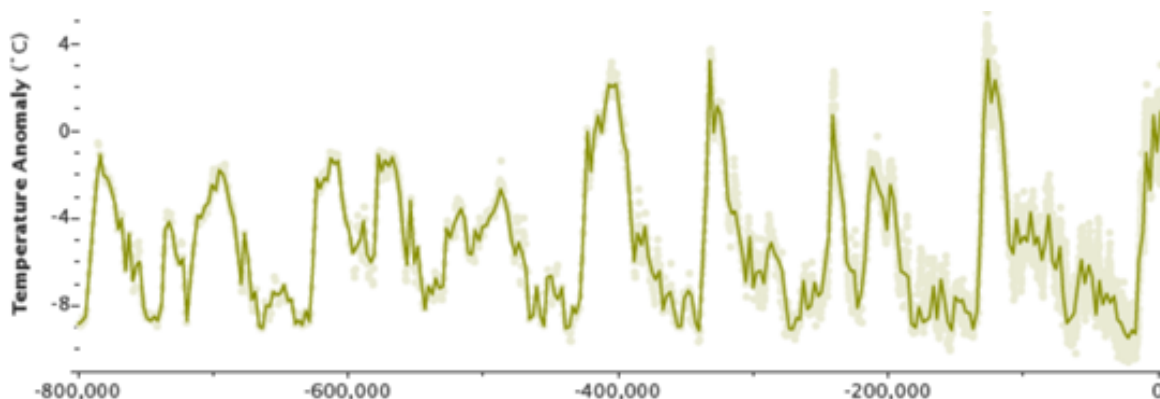
-HARSHITA HARI

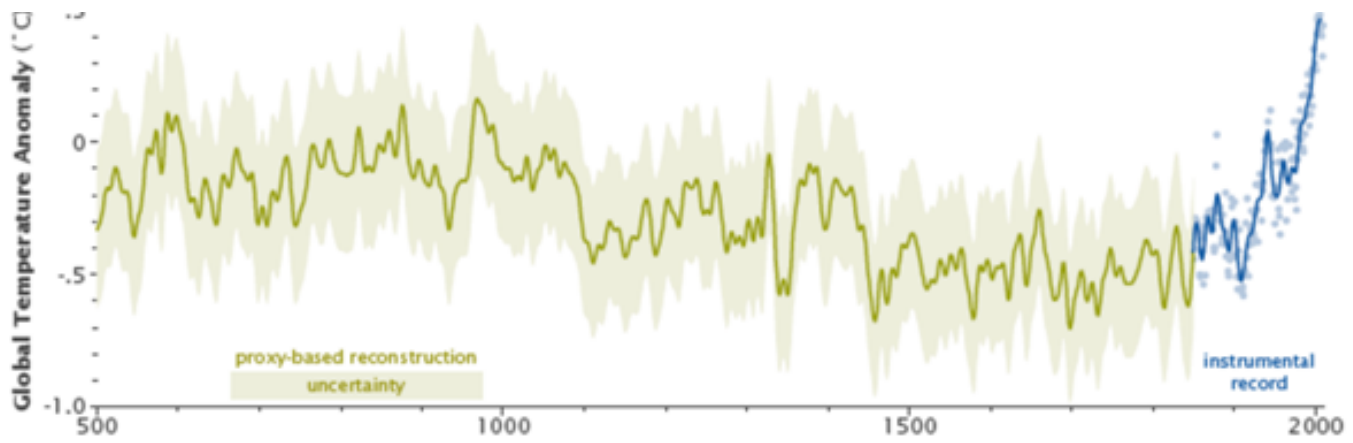
THE SINKING WORLD

Indonesia is a ravishing country known for its bewitching Bali, a province, and the world's second-largest populous megacity, Jakarta. But soon Indonesia will change its capital from Jakarta to Borneo island. After Venice, Houston, and London, now Jakarta is also sinking underwater. Due to the depletion in the Ozone layer over the poles, the greenhouse effect of our ecosystem has boosted leading to the melting of ice sheets and glaciers and ultimately to rising sea levels. The city has already succumbed 40% under-water and is now officially the world's fastest sinking city.

The problem these days is that those areas which don't contribute to environmental pollution are suffering from environmental issues. The increase in greenhouse gases leads to a rise in tropospheric ozone and decrease in stratospheric ozone which is mainly due to increase in VOCs (Volatile Organic Compounds like CO, CO₂, black carbon, unburnt hydrocarbons, oxides of nitrogen and sulfur) and ODSs (Ozone Depleting Substances like halogenated organic gases). The ODSs increase destruction of stratospheric ozone in a repetitive cycle so allowing more UV-Rays to reach the Earth. Hence increasing the average global temperature.

Although there have been higher average temperature readings every few ten thousand years, at today's pace, with other human-caused environmental issues there won't be sustainable life in the future. Models predict that Earth will warm between 2 and 6 degrees Celsius in the next century. When global warming has happened at various times in the past two million years, it has taken the planet about 5,000 years to warm 5 degrees. The predicted rate of warming for the next century is at least 20 times faster. This rate of change is extremely unusual.





The data in second graph suggests that global temperature is warmer now than it has been in the past 1,000 years, and possibly longer.

-RAGHAV VERMA



THE CONTRASTING EFFECTS OF OZONE

Ozone is a necessity and problem too like GHGs. It is inevitable when it is present in the Stratosphere (between 15-45 km above sea level) known as Stratospheric Ozone protecting Earth from harmful UV-Sun rays. But from the past few decades the average DB (Dobson Unit – unit for measuring ozone layer's width. 100 DB = 1mm) of ozone is decreasing mainly due to excessive consumption and production of ODS (Ozone Depleting Substances). The average width of ozone which was 3 mm has decreased nowadays leading to problems such as skin cancer in humans. Even animals suffer from similar effects as humans from high UV-B levels.

Ozone can become a huge problem when found in the troposphere (0-15 km above sea level). It is the main pollutant in the formation of photochemical smog. Ozone here is formed as the result of pollution by VOCs (Volatile Organic Compounds). Tropospheric Ozone can lead to respiratory tract infections, asthma, pneumonia, and premature aging of lungs in humans. Not only this, but children born and raised in areas where there are higher levels of ozone can also experience up to a 15% reduction in their lung capacity.

Higher levels of ozone can even damage fabrics and rubber materials. This isn't an issue that only affects humans. When sufficient ozone enters the leaves of plants, it interferes with the ability of sensitive plants to produce and store food and damages the leaves and other parts of trees forcing the tree to ultimately dieback. Continued ozone exposure over time can lead to increased susceptibility of sensitive plant species to disease, damage from insects, effects of other pollutants, competition, and harm from severe weather.

A study in the USA even stated that if ozone levels in the USA were reduced by about a third 4000 lives would be saved each year.

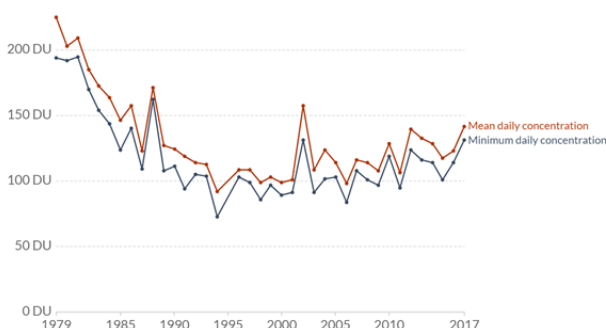
In conclusion, to reduce the harmful ground-level ozone and improving stratospheric ozone one needs to follow the guidelines established by United Nations Environment Programme and help from their level to make the Kyoto and Montreal protocol more successful.

-RAGHAV VERMA

Stratospheric ozone concentration

Stratospheric ozone concentration in the Southern Hemisphere, measured in Dobson Units (DU). One Dobson Unit is the number of molecules of ozone that would be required to create a layer of pure ozone 0.01 millimeters thick at a temperature of 0 degrees Celsius and a pressure of 1 atmosphere.

Our World
in Data



Source: NASA Ozone Watch

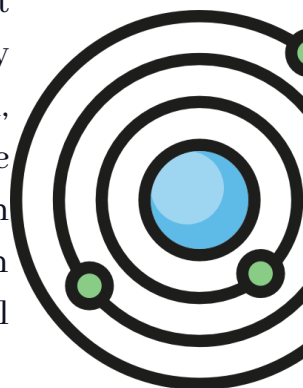
CC BY

THE SIZE OF THE UNIVERSE

The Universe is a very interesting place to be. It literally holds inside of it, all that is interesting, but nothing more interesting than the Universe in itself, and so today we shall be looking at just one aspect of the Universe that is so interesting – its Size. But, before we can do that, I must clear up some confusion about the Universe. We often use 'universe' interchangeably with 'observable universe', which is the universe that we can conceivably see given that photons have to travel from the edge of it to us before we can see them.

The observable universe is a sphere, and it centers upon the observer, meaning that each and every one of us looking out at the night sky, we are the center of the observable universe. The observable universe is like the observable ocean if you're sitting on the beach, there's a horizon out there, but of course, what that doesn't mean is that there isn't more stuff out there beyond what we see as the edge of the universe. And the radius of the Observable Universe, no matter in which part of the Universe you are, is – 46.5 Billion light-years, now get this – since the Universe itself is around 13.7 billion years old, we still haven't received all the light from the observable Universe, so yeah it is a very big place to be in, but in no way as big as the Universe.

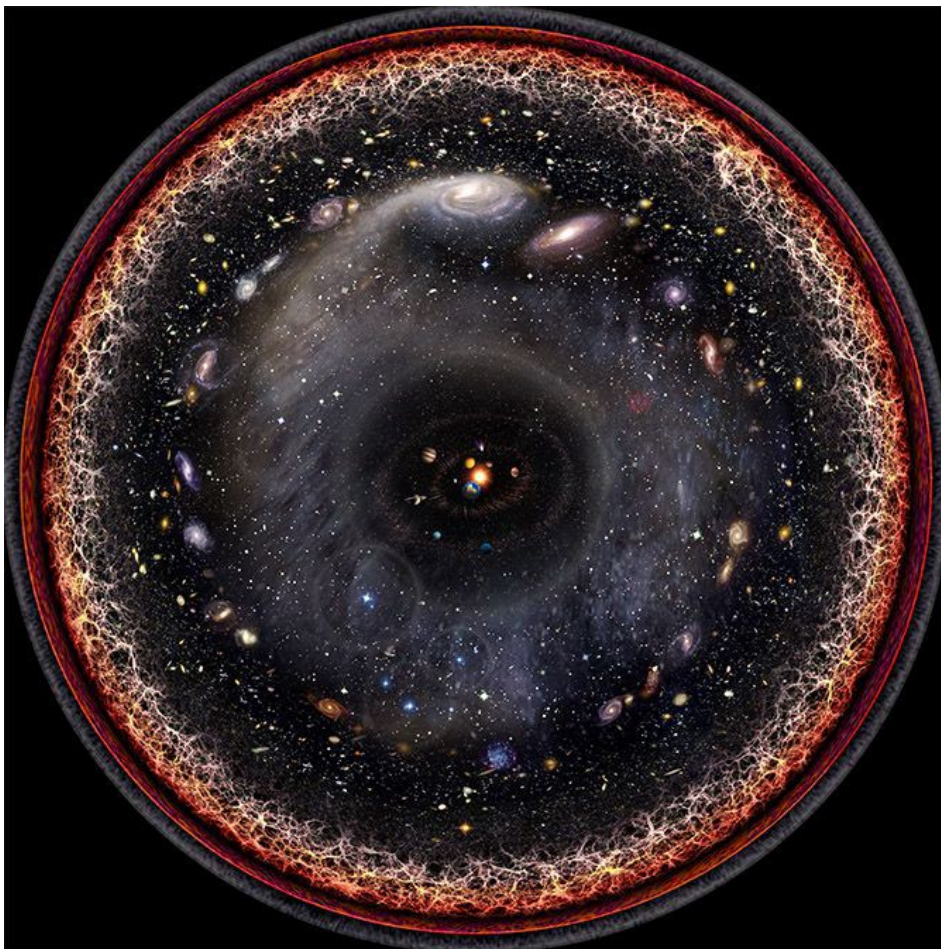
But that's not actually a very good definition of the universe, what the universe really is, is this evenly dense, ever-expanding mass of stuff that we can study and we've learned many fascinating things about. Now, time and again a simple question arises in physics. If the universe is expanding, it has to be expanding into something, if it's expanding into something, there has to be an edge. There's nothing here and there's the universe here, right, 'cause it's expanding? NO. It's actually not expanding into something, it's just expanding. I'm going to try to explain that. The Big Bang was not an explosion the way that we think about explosions, with things shooting off and you know, more stuff in the middle. The Big Bang was not like that, and the universe is not like that. Just like there is no edge, there is no center. After that cosmological moment of The Big Bang, everything existed and was evenly spaced and remains that way, though gravity like, makes little clumps, overall, the universe is evenly dense. When we say that the universe is expanding, we don't mean that individual galaxies and planets are shooting out away from one another, what we mean is that the fabric that they exist in is stretching. In order to freak you out just a tiny bit more, if you wanted to find the physical geographical place where The Big Bang started, it would be...everywhere.



We're not actually sure whether the universe's infinite, current data suggests that it is, so apparently, it's perfectly possible that the universe is infinite, and also expanding, which, bwaagh! The universe also, on the other hand, might be finite, somewhere out beyond where we can see, there might be an edge.

So, in conclusion, the Universe may or may not be infinite, it may or may not have an edge, it may or may not have a center, it may or may not be expanding into something, but one thing is certain - beyond what we can see, there is certainly more. Beyond these fair horizons of the observable Universe lies the rest of everything, and to me the fact that "everything" is such a big concept that we haven't even seen all that we can see, let alone what we can't, is a very beautiful sentiment. So, how big is the Universe? I don't really know, but I do know it is plenty big to always be able to satiate our curiosity.

-PRAMAN BANSAL





WHY THE JAMES WEBB TELESCOPE IS SO AMAZING

I believe that there are two ways to make the world a good place. You can decrease the bad stuff, or you can increase the good stuff. Now these are not mutually exclusive things. But there are also not the same things. And it's clear that decreasing bad stuff is extremely important - probably, in the end, more important than increasing good stuff. And thus, when I talk about the space program, people are always like, "NASA's money could be better spent on services for humanity!" And to them, I say: I do not want to live in a world where we only focus on suck and never think about awesome. If we lived in that world, then people would play basketball by having both teams stand and guard their own hoop the whole game with the ball sitting in the middle. And then, at the end of the game, we're supposed to all celebrate cause no one scored any points against our team. We have to guard the hoop, and we have to try and prevent bad things from happening, but we also have to make good things happen. And that is why I love the James Webb Space Telescope. It effectively increases the good stuff by orders of magnitudes. So here are the top five reasons why the James Webb Space Telescope is so amazing!

It is huge! The total mirror size is seven and a half times larger than the Hubble Space Telescope's mirror. The heat shield is the size of a tennis court. This might seem trivial, but its size is one of the principal things that allows it to see so much at the same time so it's actually very important to the mission.

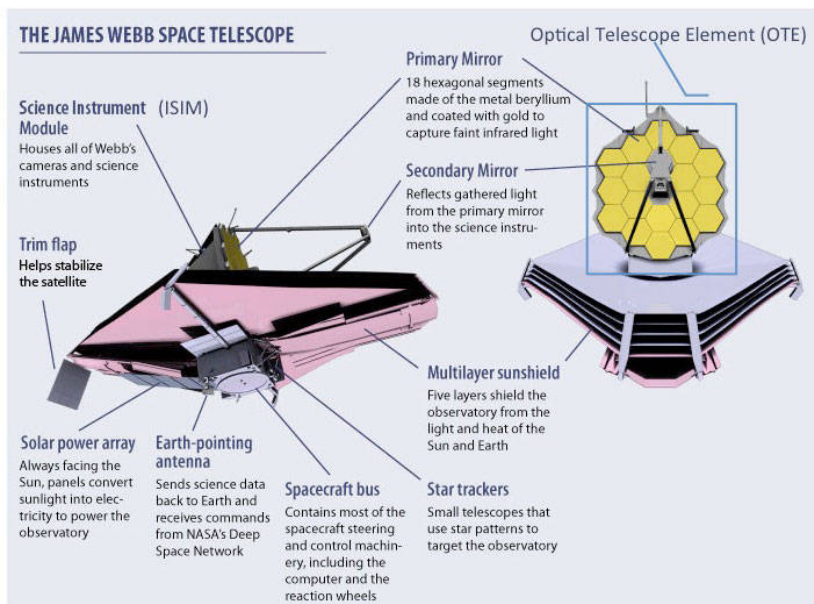
Number four! It's an origami that has come to space telescope - life. Because it's so huge, it could never fit in its full form at the top of a rocket ship. And so, in order to fit into the rocket, it's folded up. And then when it arrives, it unfolds in twelve thousand different marvelous little ways that could go wrong at any moment. And oh woe for humanity, no one is going to be there to see this thing open up, but luckily, the wonderful computer animators at NASA have given us the images that you can go look at for hours.

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Number three! It will operate one million miles from Earth. That's about four times as far away from the Earth as the moon is. The Webb Telescope actually orbits the Sun, that's a simplification. It's actually in the relative stationary Sun-Earth Lagrange Point Two, which I'm not going to try to explain to you right now. If it screws up, there's no way to fix it. You may have noticed that we went to fix the Hubble like ten different times. Well, we're not gonna get that opportunity with the James Webb Space Telescope. One-off. One chance to do it right, or it's a six billion dollar piece of space-junk. That is tense!

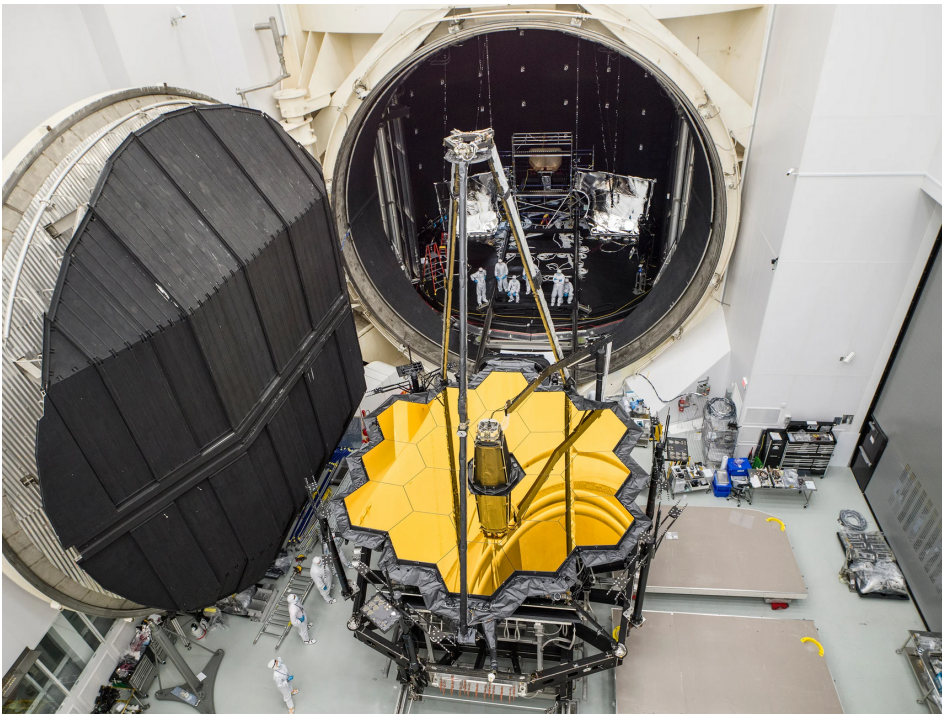
Number two! It will be able to see planets orbiting stars in our galaxy. Individual planets - if the James Webb Space Telescope was twenty-five light-years away, it could see the Earth. It can also determine the chemical composition of the planets, and it can peer into stellar nurseries to see planets as they form, watch solar systems forming!

And finally, the James Webb Space Telescope can see thirteen point four billion years into the past! So, this seems so supernatural I know, but it's actually a very common phenomenon. See, the Universe is a vast place, so vast in fact that light takes years to reach different celestial bodies. So, let's assume that we have a star that is 500,000 light-years away from the Earth, so all light from that star takes 500,000 years to come, so the light is effectively 500,000 years old. So, when we do look at the star, it isn't what that star actually looks right now, it is what the star looked like 500,000 years into the past. Now, the reason why it's so particularly impressive that the James Webb can see 13.7 Billion years into the past is that the universe is thirteen point seven billion years old. We will be seeing the first galaxies as they form, the first stars as they form.



And guess what? None of this is necessary to life on Earth. None of it's going to help us cure malaria or reduce childbirth mortality or install a democracy in Oman. But it is awesome, in the truest sense of the word awesome. For me, the Webb telescope is a culmination of all of humanity's progress up to this point, like; it's the most technologically sophisticated thing we can do. Every civilization passes things down through the ages that we all marvel at and wonder at and say, how did those people do that, how could they be capable of that? And I feel like the Webb telescope, that's our Pyramids, that's our Hagia Sophia, that's the thing that we pass down, so that future generations can say, wow, they worked together, they put aside their differences and they put a telescope in the Sun's periphery that can see the very first stars. And to think that I got to be there when it happened, I'm very grateful.

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