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WHAT MAKES AIRCRAFT AERODYNAMICALLY EFFICIENT?

Ludwig Widodo 8E



In this article we will be talking about what are the main factors of making aeroplanes more efficient, the importance of reducing the amount of fuel used by making the design of an aircraft more aerodynamic and what impact it would have on the environment. We will also discuss what modern implications have been used today, and how they can be advanced further.

How do aerodynamics affect a plane?

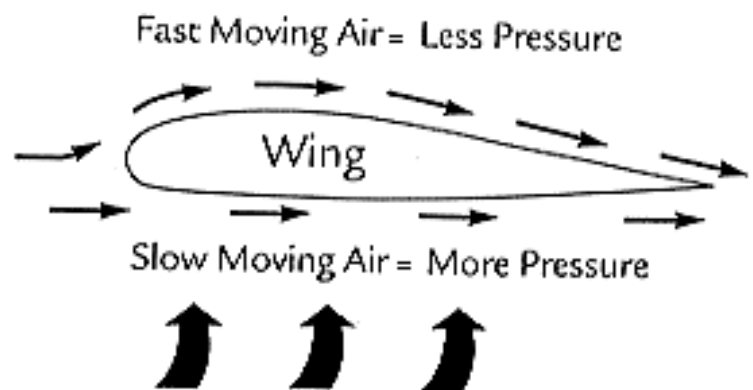
The shape of the plane is what gives its appearance, but it also is a key role in how it performs. Looking through the history of planes from the past to the present, the designs seem to have changed significantly. A standard feature of almost all planes is a domed or pointed nose, this is because they have to be aerodynamic.

The four main forces in aerodynamics are thrust, lift, gravity, and drag. Drag slows a plane by having an opposite force to which the plane is moving at, which results in the journey from one place to another to be extended, also burning more fuel.

A part of a plane that needs to be designed correctly to have lift are the wings. The design of the wing works by having the bottom straight while the top is curved, a curve on the top of the wing creates an obstacle for the air to pass therefore making it longer to get over the wing. This creates low pressure air which moves fast. The bottom is straight so there is no large obstacle in which the air has to pass, which creates high pressure air which moves slow. The wing creates lift by moving to the area with lower pressure and the force is directed by the angle that the plane is at, or the angle of attack.

Another force in aerodynamics is gravity. Gravity is the force that pulls an object down. In the case of a plane, the force can be matched with the lift generated by the wing.

Finally, the fourth aerodynamic force is thrust. Thrust is the force made by the engines to push the plane forward and gain speed. Thrust is important because without enough of it, a plane could not fly very fast as the force of drag is against it which is why most engines on planes create much more thrust than drag.



How can the improvement of aerodynamics on planes affect the environment?

The improvement of the aerodynamics, in particular the reduction of drag, can improve the efficiency of a plane by needing less thrust from an engine. This means that it should burn less fuel.

A plane that is aerodynamically efficient is the Airbus A350. The weight of the plane is 192 tonnes, with a fuel tank capacity of 138,000 litres, and the wing design has curved winglets. The plane was made mostly of carbon fibre reinforced plastic. This made the plane lighter and they also made the aircraft more aerodynamic by developing a new nose for the plane. The fact that the A350 reduces the fuel consumption and carbon footprint means that it is some progress to make the aviation industry more environmentally friendly.



Another implication of the forces of aerodynamics is in the Boeing 787. It has a wing design that can withstand high amounts of pressure and this can be noticed by what it looks like in the air, the wing of a 787 significantly bends more than different planes as it creates more lift and the engine of the plane is much more efficient than other planes

What is a concept of more aerodynamically efficient parts of a plane?

NASA has created a brand new control surface for aircraft called a variable camber continuous trailing edge flap for not just for aerospace engineering but also for possible aircraft. It provides the same capabilities of a normal flap but reduces the drag, if these flaps are paired with fuel efficient engines they could not only fly with less drag but also cut the costs of fuel for companies.



What are some implications of the 4 forces of aerodynamics in aviation?

A special implication of the forces of aerodynamics in aviation was the creation of the Concorde in 1969. The plane had a unique design which featured 4 powerful engines which had afterburners, a new wing design, and a new nose design. The aircraft was equipped with 4 Rolls-Royce Snecma Olympus 593 engines. It flew faster than any commercial plane ever before, flying at a staggering mach 2.04, twice the speed of sound..

The wing was modified as there was too much pressure at such a high speed. The nose of the plane had a special feature which was to extend and angle downwards, this was because the pilots had to have a high angle of attack on landing as it would create more drag to slow down from a high speed.

What features have been introduced recently by aircraft manufacturers?

Airline manufacturers are positively impacted from competing with each other, and it has helped many innovations come to the aviation industry.

They have different variations of ideas, some have brand new ideas. For example, recently Airbus has made a small prototype plane that uses a feature called a hinged wingtip. This feature has been used before for military purposes such as in fighter jets but not on a passenger aircraft.

The model was called the Albatross One and the feature helps with reducing the impact of turbulence as the wingtips move according to the wind.



Another example of a more efficient part of a plane is on the upcoming plane the 777x with its folding wingtips, the feature was implemented as the wing design that they are using is much wider and it takes up quite a large area, so they decided to implement the folding wingtip system.

The wingtips fold up when taxiing on the ground and when stopping at a gate for passengers to disembark there is no need for a wider space between the different gates. While on the runway the plane will fold out the wingtips which are designed to make the plane more efficient in flight.

In conclusion in this report we have discussed how significant of an impact aerodynamics has on a plane, the environmental impact, the modern implications of the 4 forces of aerodynamics in planes, and possible solutions to make aircraft more aerodynamically efficient. In my personal opinion improving these aspects of aviation could be a large step to making aviation more accessible to more people, and work as aerodynamically efficient as possible, this is because climate change today is an issue and by lowering the carbon footprint, companies and the world would benefit.

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SELF DRIVING CARS

Arnav Gupta 8R

As humans, we have been finding ways of improving our lives. One area that we are changing all the time is the way we move around, the way we transport. Two centuries ago, most people had been walking on foot or riding on horses. Much before that people had found out how to keep afloat and allow them to travel far distances. Boats came out as early as 1300BC. Trains were a means of transportation in 1803, but they were so slow that people could hardly breathe. Buses came in the 1820s, they were horse-buses. And finally came cars in existence in 1885.

From the 20th century till now we have been improving these means of transportation. As technology has been improving, some planners have been anticipating that 'self-driving cars' also known as autonomous cars will be on the highways in a decade or two.

Now you might ask yourself how would these autonomous vehicles work without human control on it. Although there aren't any legally operating fully autonomous cars working now, there are partially autonomous vehicles.

Here is a diagram showing the capability of autonomous driving on a scale of 0-5. Depending on different companies and cars models, currently autonomous driving is at a level 2 or 3. The basic parts an autonomous car would have are, a LiDAR sensor at the top the car, video cameras at the front of the window, radar sensors at the front and back of the car, ultrasonic sensors near the tires of the car. All these features would connect to a central computer just in front of the back tires. The central computer would analyze the findings which would manipulate the steering system of the car. It is really essential for the software to understand the rules of driving to allow the car to drive safely.

Level 0: All major systems are controlled by humans

Level 1: Certain systems, such as cruise control or automatic braking, may be controlled by the car, one at a time

Level 2: The car offers at least two simultaneous automated functions, but require humans for safe operation

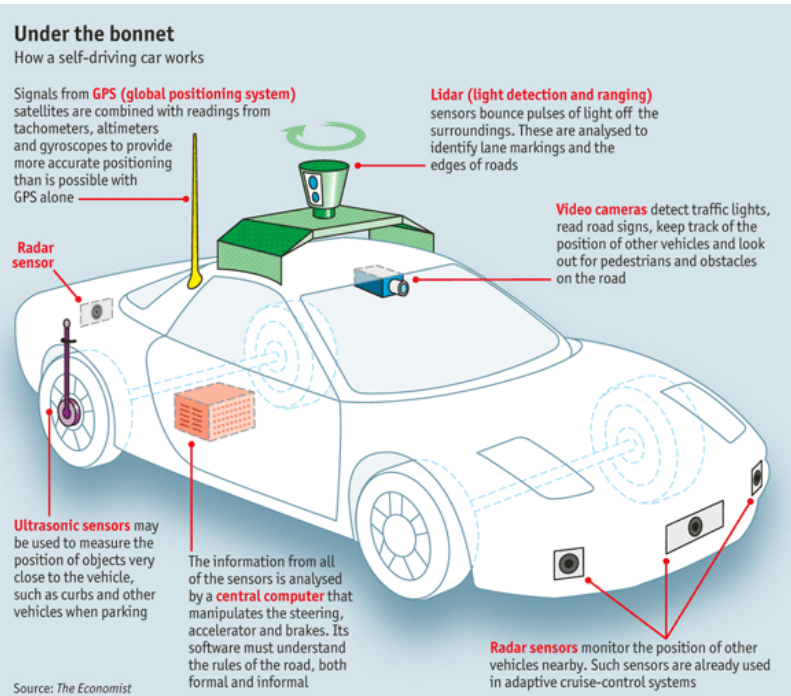
Level 3: The car can manage all safety-critical functions under certain conditions, but the driver is expected to take over when alerted

Level 4: The car is fully-autonomous in some driving scenarios, though not all

Level 5: The car is completely capable of self driving in every situation



A LiDAR sensor is needed so that the car can determine the edges of roads by sending off pulses which bounce off surroundings, which are then analysed by the central computer of the car. Video cameras are needed to detect traffic lights, pedestrians and obstacles on the road. A lot of radar sensors are essential to look out for other vehicles. Ultrasonic sensors are also needed to measure positioning of objects really close to the car which would be often used when parking.



Autonomous driving could be the answer to global warming, as transportation is the cause of 13-14% of today's global warming. Planners suggest that autonomous cars will either be fully electric cars hybrids because cars run 40% better on electricity, and they are also eco-friendly.

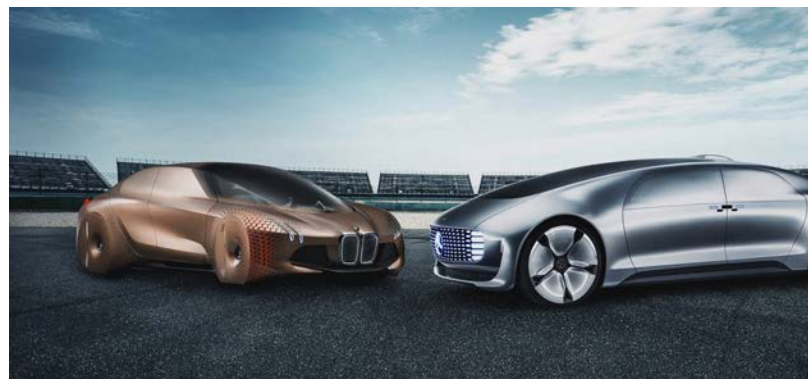
Autonomous driving can also help us in many other factors. As autonomous cars would take up less lane space with the use of high quality sensors and cameras, therefore we can use the extra space by making bicycle lanes, wider pavements or more road-side parking. This means we would need less multi-storey high parking lots which we can build as offices or apartments. Finally, self-driving cars ease congestion as they have the capability to communicate with other cars but also go at a fast pace or slow pace to avoid frequent stops.

However with such good advantages, there are a lot of things to overcome. First of all either if people choose to buy a driverless car or use a robo taxi, both of them would be relatively expensive. A fully driverless car would cost about USD \$150,000 and a robo taxi would cost about \$7,500 every year.

The second thing is that there is always potential for a self-driving car to go wrong. This could cause car accidents. Another disadvantage is that people can get a door to door ride so that means they would particularly stop using buses, trains and other means of transportation. This would cause people to lose their jobs.

The final disadvantage to autonomous driving is that there is a huge potential of privacy loss. A car would be receiving or communicating with data centers, therefore a person's location would be potentially accessible to people or organizations who could hack into the network. This could change the attitude of people to autonomous driving, therefore making people not wanting to choose travelling in this way.

All in all, autonomous driving is a new step to human-kind's new inventions, as it is somewhat eco-friendly, it takes up less space in a lot of areas such as garages, lanes and multi-storey car parks. It would also cause less congestion on roads. But as there are advantages, there are also disadvantages. A few examples are there are expensive, they have chances to go wrong, people would stop taking other means of transportation and people could lose their privacy. But as technology is increasing at a rapid speed, people say that we will be able to solve all these problems in no time.



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DO WE REALLY EXIST?

Alexandra Lai 8W

For thousands of years, humans have always wondered how and why we exist. In an attempt to solve this question, people over time have come up with their own creation stories, for example, Christianity, Hinduism, Buddhism, the list goes on. However, science-wise, the leading explanation to our existence lies in the hands of this one controversial theory: The Big Bang. Many argue that this answer to our presence could just be another creation story, despite many scientists who are convinced that it was the singular start to everything that exists, following from two strong theories in science, the Quantum theory, and the General relativity theory, both in which revolve around physics.

Why We Don't Really Exist

Give yourself a while to think. Do you really exist? Are you conscious? For as long as scientists have studied and researched, there is no universally accepted definition of life. Scientists from different eras and periods of time have all attempted to define this question with information they had in their period of time, for instance, Aristotle, and later on in the 17th century George Erns Stahl and many more. But when looking back at their eras and periods of time, we can notice a big gap in between the knowledge we have nowadays, and the understanding they had when existing. However, because such a popular question has not been successfully answered and proven, people begin to ponder why we exist, and why defining life itself is so difficult.

Why haven't famous scientists and philosophers found any set of properties that separates the living from the non-living?

The simple way to answer this is to state that such a property doesn't exist. German philosopher Markus Gabriel, convinced that the world doesn't exist, stated his view on the question, believing that in order for an object to exist, there must be specific rules or laws characterizing objects in a certain way. One way he tried to prove this was by explaining how numbers are based on the laws of arithmetic, and the government by the rule of law, stating that if one were to prove that the world existed, there would have to be a universal law. But, as Gabriel claimed, there is no such thing as a universal law or concept of existence that covers everything, hence indicating the world does not exist.

It is true, however, that no one has really informed us what real existence is, except some things which exist in their fields, e.g. Santa Claus, or God, for God exists in the Bible and Santa Claus is not a real man. There are no areas of rules which characterize whether we exist or not, neither are there universal laws.



Why We Exist

Although there is no specific universal law to cover the reason for why we exist and how, when we look closer into the different categories the laws split into, one of them may catch our attention towards this topic. The Immutable and Mutable, is a law that separates the rest of the laws into two categories: Immutable, indicating laws that have already existed and will continue to exist, and mutable, laws that can be 'exceeded' or 'better used' to create a person's ideal reality. Other laws that are considered to be 'universal' consist of gender, vibration, relativity, rhythm, and more. Although it is unknown exactly how many there are, certain experts and websites claim to have 7, 12, and 20 unique laws that shape our lives, the main convention that 'stands out' regarding this topic, is the Law of Cause and Effect. This is considered to be a very straightforward universal law, simply implying that all actions, in this case referred to as the 'cause', have an effect. These universal laws simply cannot be escaped from, as they are the laws and facts in our lives. But what if these laws could prove our existence in this galaxy?

If we were to imagine that our existence was the effect, there would be a need for a cause in order to create an effect in the first place, otherwise such an effect would not have happened.

When looking at the science spectrum of why we do exist, scientists have claimed that the Big Bang, the most common theory of how the Universe began, where a big explosion happened out of nothing, slowly developed the solar system we know today and potentially other galaxies out in the unknown. This could have served as the cause for the effect of humans' existence, in which followed by Earth's cooldown as well as the slow build-up of organisms and bacteria that slowly formed existence on the planet. However, the same question remains: How can we clarify that the Big Bang actually happened?

George Lemaitre, a Belgian physicist, interpreted data and evidence from Edwin Hubble and Einstein's equations of general relativity and thought that our current galaxies would have started out together in what Lemaitre called the "primeval atom". This theory was backed up by several types of evidence, for example, the fact that we live in an expanding universe and that galaxies are getting farther away from all other galaxies. People claim to be able to see the nearby galaxy's redshift, meaning how light shifts towards longer wavelengths. One similar example is the loud siren of a police car or ambulance. As the ambulance approaches you, the siren's sound would have increased, receding as it drives away. If an item were to move closer, the light would move more to the blue side of the spectrum, which is called blueshift. But since another galaxy is extremely far away, we are only able to see redshift.

At the end of the 17th century, a man by the name Leibniz inquired why there was something rather than nothing. He responded by saying that God created the universe, along with us. Many people, in fact, most of the US nowadays believe in Christianity, and that God created the entire universe, along with the living atmosphere on Earth, within the 7 days of creation. But, no one has proof that God exists in this world. This does not necessarily mean that God doesn't exist, but that there is no proof that he really does, excluding the Bible. Another religion in which many believe is Hinduism, which consists of numerous creation stories.

Will we ever know?

Current modern technology, despite its really modern and sophisticated advances, is still not strong enough to look back and see what really happened at the very beginning of our universe. But, as time passes, maybe one day we will really know how we all came to life on the third planet from the sun. How did God exist in the first place? Did the Big Bang really happen? These, ladies and gentlemen, are ultimate questions that we do not have the answer to yet. For now, let's just stick with believing what we feel is true.

(An image of a 'spotted nearby galaxy', taken by Hubble Space telescope)



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IS MORNING GLORY THE KEY TO OUR FUTURE?



Airi Tachino 9D

Introduction to the terminology:

Though there are more than 1,000 species of morning glory found to be existing in this world, all of them have a similar blossom. Their elegant, colourful, and sometimes slightly scented funnel-shaped flowers are another delicate feature. But that isn't the main trait of this charming plant. It is that they are a significant example of a bioindicator, and also known as a photochemical oxidant indicator.

Bioindicators are known to be any organism (ecological) that signify the changes in normal, standard conditions of their environment.

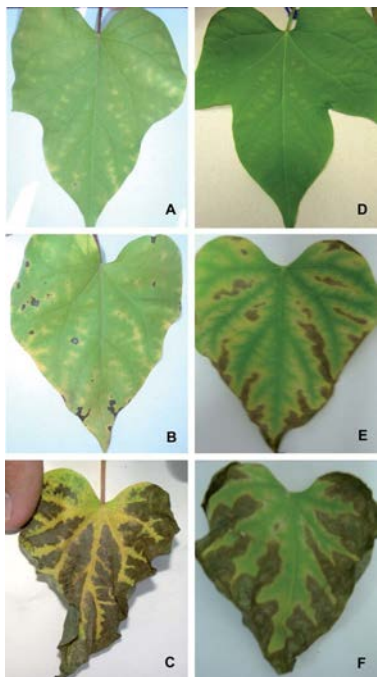
Photochemical oxidant indicators, on the other hand, help show the chemical reaction that takes place between Nitrogen (di)oxides (NO_2) and VOC's (volatile organic compounds), as they form harmful air pollutants, causing air pollution. The morning glory is known to be able to detect ozone, which is shown to be extremely harmful and toxic.

Bioindicators:

Before going into the specific area of the morning glory's, I would like to introduce what sort of plants are considered to be bioindicators. They come in largely two types, a sentinel and a detector. Sentinels are known to grow at fast rates, are delicate towards changes in ozone levels and aren't native to the environment. They need to be introduced there, as they (should) have been raised in a distinctive area - grown to charcoal-filtered air. They show distinctive reactions to ozone when it is at a high concentration and exposure. Detectors are native to their environment, and only the sensitive ones will show reactions. The morning glory is a type of sentinel.

The indication that it showed, as a bioindicator, is unique in its own way. According to Krupa and Manning (1988), they state that common foliar damage would be that the leaves were shown to be showing symptoms such as; flecking, stippling, pigmentation, chlorosis, and premature senescence. Acute injury, which was the flecking and stippling, can show signs such as tiny spots that are coloured as faded white, grey, brown because of dead or injured palisade cells.

As for the chronic injury, the pigmentation would be the leaves changing to a reddish-brown. This is known as bronzing, as well as reddening. Also Chlorosis, or the loss of colour from the insufficient value of chlorophyll, and the premature senescence, which is simply the early loss of leaves/fruit on a plant. These injuries were usually/mostly on the adaxial. In addition to this, according to an experiment conducted by Isamu Nouchi and Susumu Toyama, ozone was shown to affect phospholipids and MDA content.



How and Why Plants React This Way:

Ozone, in the first place, enters the plants through the same areas during gas exchange. They enter from the pores of the stomata, and from the openings of the guard cells, they are able to enter into the mesophyll cells, slowly oxidizing the tissue there.

The issue with this is that ozone was found to be producing stress-inducing proteomic changes, simply meaning that ozone actually reacts and decreases proteins in the chloroplasts. Though this (for now) has been shown on beans if the morning glory faces the same effect is unknown. There is also evidence showing that this slows the process of photosynthesis (as the damage to the leaves previously mentioned also happens to make them smaller), resulting in slower plant growth, as well as harming other functions. These large damages to the plants leave them vulnerable to other destructive aspects, such as pests, diseases, etc. Fortunately, there are chances where the plants are able to battle this, by using their vitamins (specifically ASC, or ascorbate) to stop the ozone from oxidizing. Actually, scientists and other plant physiologists are still trying to find out the precise process of this, and where this has an effect in the plant cells as well as its pathways and locations. And these factors are also harming our crops and vegetations, as studies in America show that there were issues in harvest because of this.

How This Applies to the Real World:

Just knowing this seems like it is quite a useless thing. However, research and studies are starting to realize that plants may not only be able to inform us about abnormal changes in our earth, but also help combat these air pollutants. Looking back at the fact that the damage that ozone is causing makes the plants look poor in quality, as well as lose nutrients and other components, this can only seem to be a negative element.

Glossary:

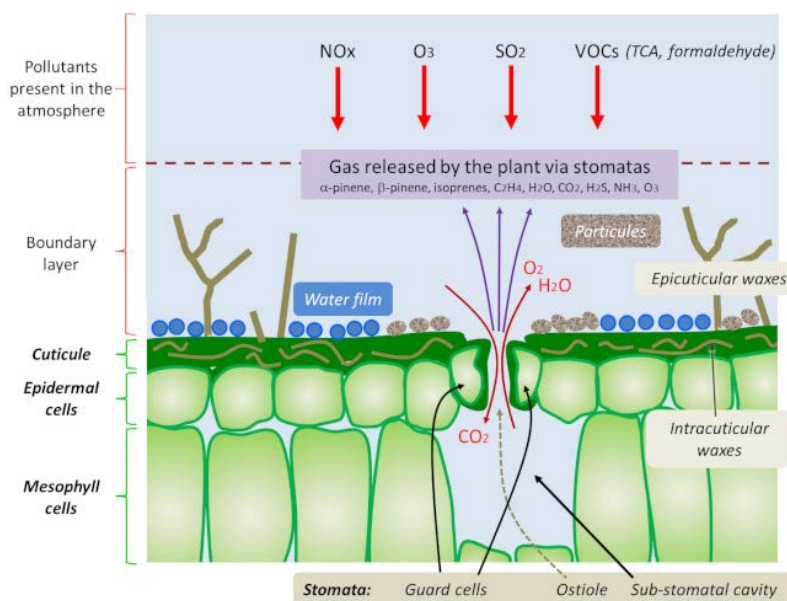
Ozone (O_3) - itself is usually found in the troposphere to make the ozone layer, and rarely in the atmosphere

Palisade cells - found in the mesophyll, also known as the leaf cell

Chlorophyll - found in the chloroplasts, and is the green chemical or pigmentation.

But if we look at this from a completely different perspective, this may be the key to spark more action towards improved and perfected selective breeding in plants. Breeding them to avoid them from having looks that may decrease their value in the markets may be the key to being able to make plants that can be stronger against weakening effects from ozone and other harmful air pollutants.

If we continued to look at the specific parts in plant cells where ozone has slowed down plant growth, and became able to genetically modify and breed damaging plants (like the Mikania, and other weeds) to become more weak like the current bioindicators are, using it we could allow the weakened invasive species to reproduce using the wind. This would also help with using a more environmentally-friendly approach instead of having to harm the environment with pesticides, and other methods.



Adaxial - top surface of the leaf

Phospholipids - a type/class of lipids (that make the cell membrane)

MDA content - malondialdehyde, an organic compound and biomarker

Gas exchange - how plants exchange oxygen for carbon dioxide

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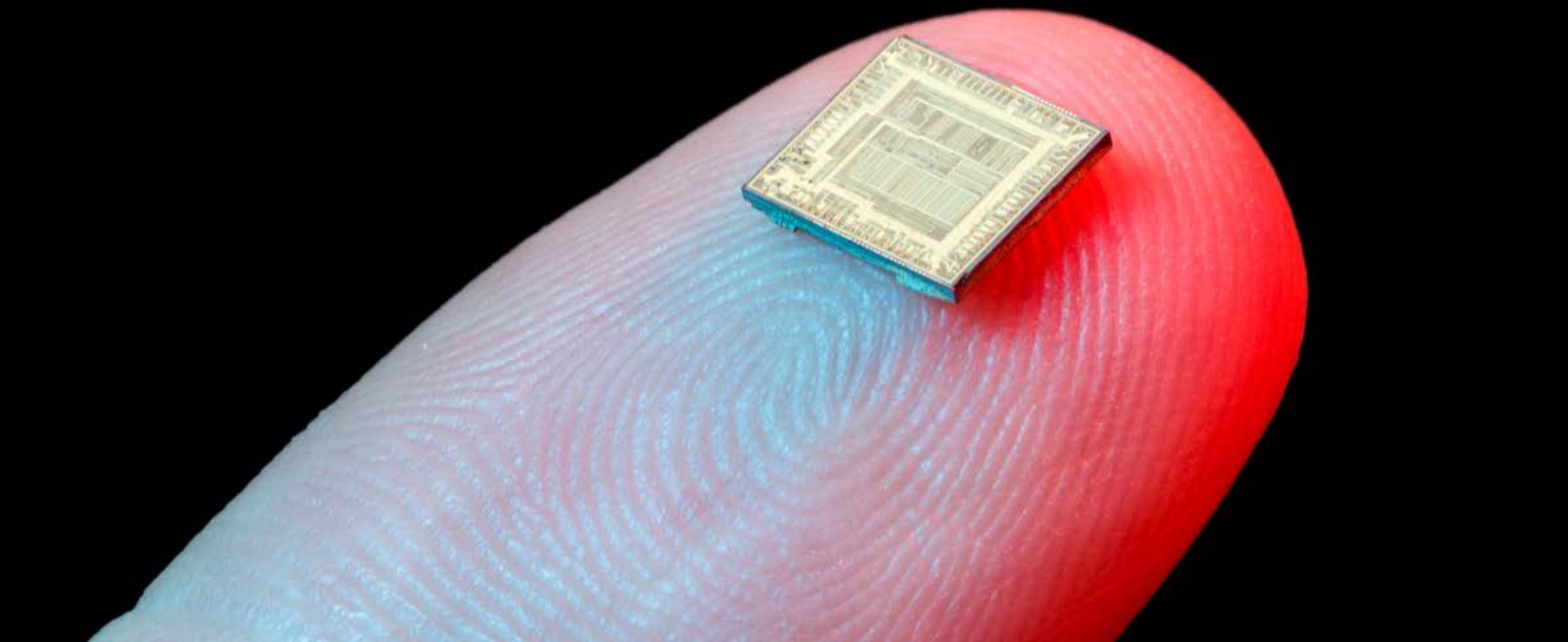
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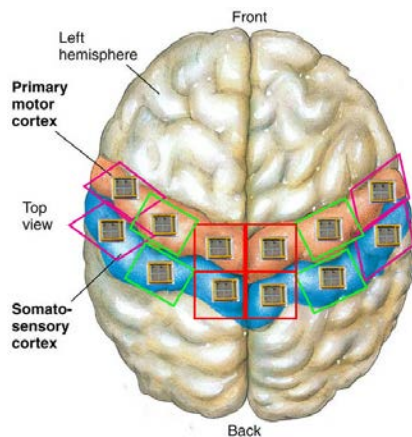
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BRAIN IMPLANTS

Shantal Sin 9E

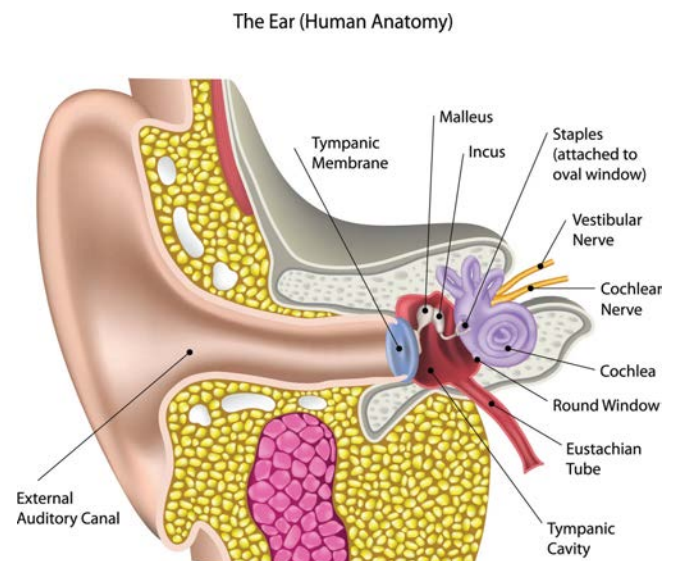


Did you ever think of turning your brain into a computer? Knowing different languages without actually learning them? Recovering lost memories, downloading and learning new skills quickly? It is now achievable!

Brain implants are chips that are planted inside the human brain's cortex. It can help blind people, military soldiers and more. The human brain is made of complex structures and different parts, it is a great discovery for scientists, and they wish to develop a better technology based on it.

Different types of brain implants

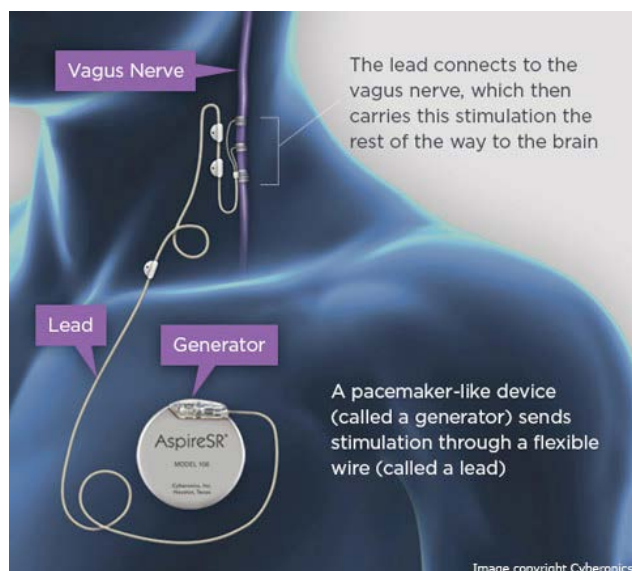
According to statistics, over 3 million people around the world are living with artificial implants. A cochlear implant is one of the most popular implants in the world right now, as it's an implant that allows deaf people to hear. An external implant will be planted outside of the brain near the patient's ear and the internal part will be placed in the cochlea with small wires and electrodes. The wires will send a signal to the cochlea nerves to inform the brain in order to produce hearing sensations. But it cannot recover 100% of the patient's hearing, they will need physical therapy and treatment to cope with the implant for better hearing.



The popularity of artificial implants is increasing and scientists estimate that by 2040, brain chips will be commonly used. Brain chips can also help people with psychological problems like PTSD, anxiety, depression, etc. A brain neurostimulator will be implanted in the lateral orbitofrontal cortex that improves major mood swings and depression. The lateral orbitofrontal cortex is the key structure of human emotions. It is located above the eye sockets and has connections with the limbic system structures. Once the implant is inserted in the patient's brain, the doctors will then apply various levels of electrical current.

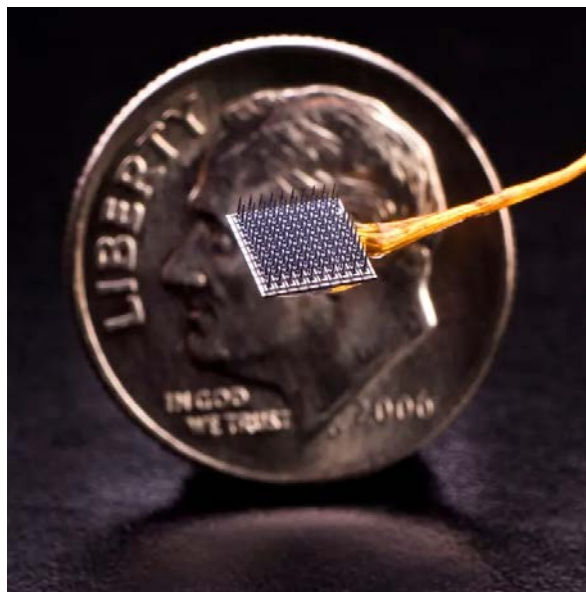
A 56-year-old woman, who is diagnosed with major depression, agreed to put a chip in her cortex to help with the situation. She claimed "I feel positive, relaxed". There were also similar responses from other patients who are also diagnosed with depression.

Another type of chip implant is designed for people who commonly suffer from seizures, it is called the Vagus Nerve Stimulator Implant. A stimulation device will be placed next to the collarbone and a wire will be connected to the vagus nerve. If the patient is having a seizure or appears seizure symptoms, the device will fire signals to the brain. The patient won't be able to tell if the device is functioning or not, the possibility of having a seizure will be decreased by 20%-50%.



Disadvantages and concerns

Brain implants can possibly be the future but the implantation surgery can be risky. The human brain is one of the most complex areas of the human body, and if something goes wrong during the implantation, the patient could die or obtain serious brain damage. There might also be some side effects. What if the brain chip overheats? What if it's damaged? These errors might happen as it works similar to a computer. Further, the price of brain chips is not something everyone can afford, you will have to pay for the surgery, insurance, hospital, etc. The total cost can be around USD300,000 (HKD 2,400,000), it's that expensive because it is still new to the market and not yet commonly used around the world.



The future of brain chips implantation

In 2016, the founder and CEO of the famous electric car company Tesla, and the chief engineer and designer of SpaceX - Elon Musk - shocked the world with his idea: inserting AI chips into human brains.

As mentioned above, brain chips can help with diseases and mental illness but Musk wants to take it to the next level. He said that he and his company wishes to improvise their chips into "a tertiary layer of digital superintelligence".

He also said that the production of the chip will take quite a while for him and his team to produce a high-quality, sustainable and reliable chip. They have to consider the sensitivity of the brain as it is very electrochemically active. But the surgery will be as easy as the Lasik surgery. If the chip will be planted in the brain, the limbic system will be the primary layer and the cortex will be the second layer.

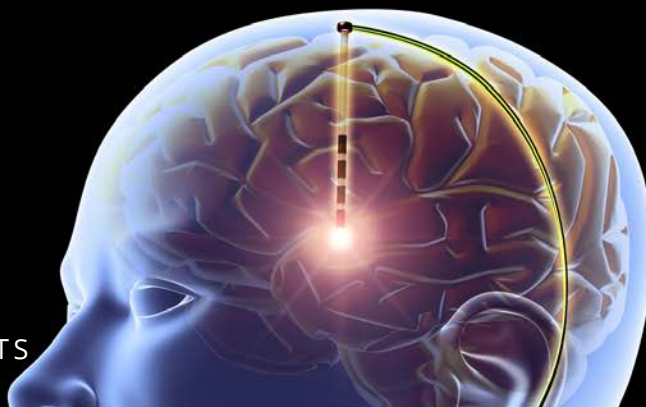
Are brain implants the future of thinking?

Edward Chung, professor of neurological surgery, and William K. Bowes Jr., the Bio-medical Investigator at UC San Francisco said that they wouldn't be surprised if brain chip implants will be commonly used in 20 - 30 years later. They also said that brain chips implantation is also an evolution and pathway to the future bionic humans. They wish to use this technology to enhance the knowledge of mankind and restore memories that we might have forgotten. The future of brain implants will be an advantage to humanity as we could boost our comprehension in different aspects and associate with the knowledge that we learned.

In my own opinion, I think brain chip implants are a great way to cure diseases and make our lives much easier and convenient. But in that way, we will slowly become robots, just like a computer, and our way of thinking could possibly be affected by the chips and manipulated by others. I wouldn't want others to interfere with my own opinions and let others see what I am thinking. Privacy is also one of my concerns. Will anyone see what I'm thinking? Will they be able to control me? Who is behind all this? However, if brain chips are used appropriately it would be the universe's lifesaver by learning a wider range of things, curing diseases, creating communication devices, etc.

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ONEIROLOGY: THE SCIENCE BEHIND DREAMS

Sophie Luk 9N

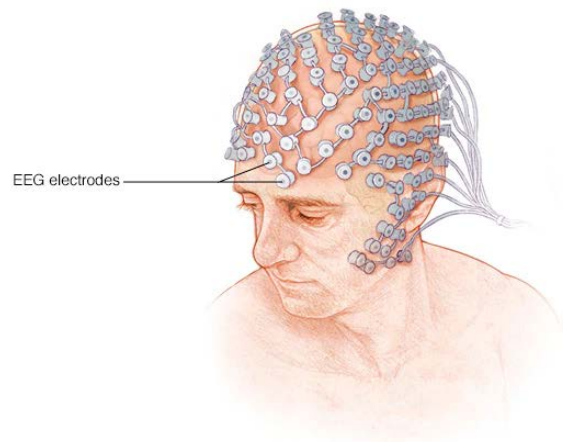


Vivid, illogical yet strongly emotional; dreams are one of the most mysterious phenomena humans have ever encountered throughout the decades. For a time it even seemed supernatural to us that such strange images can appear as lifelike as reality one second; just to be forgotten the second we wake up. Over the years, scientists and psychologists have worked; though not exactly as one; to answer the questions emerged since we first knew about dreams: What are they? How do they occur? And most importantly, why do they happen?

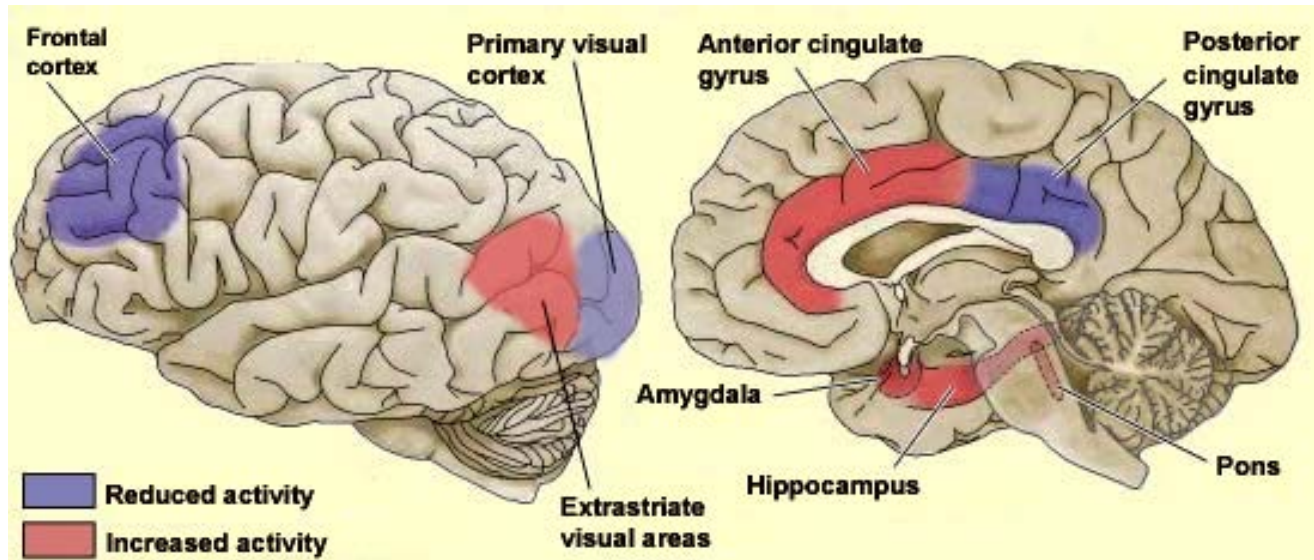
The science behind dreams

A lot of what we know about dreams today is due to advanced brain imaging technology developed over the years. The electroencephalogram, also known as EEG, was one of the most influential. This machine measures electrical impulses, including the patterns of electrical movements in the brain, but does not require inputting anything into the human body. EEG led to the discovery of the 5 stages of sleep, which repeats several times every night. Out of these, the first two stages are classified as light sleep whilst the latter three are classified as deep sleep.

With the help of EEG, we also know that dreaming occurs during the fifth and last stage, the REM period because this is when the brain's neuroelectrical systems are activated to a stage almost as high as they would be when awake. REM stands for "rapid eye movement" as, during this period of sleep, people's eyes move quickly in all directions under their eyelids. Irregular heartbeat and increased breathing are also present during REM.



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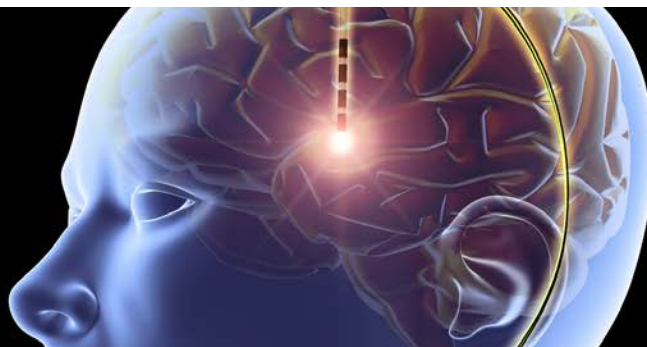


When we dream, the “default mode network” in our brains is activated. This is a function that remains turned on during resting periods like REM. These functional areas include the brain stem, which controls the signals given to the rest of the body as well as basic body functions like breathing; the limbic system which controls memories and emotions, with the two main sections at work being the amygdala involved in the production of normally negative emotional reactions like fear and anger as well as the memory of them, and the hippocampus involved in important memory roles; the occipital temporal-parietal junction which receives, examines and stores information, and is involved in generating 2 or 3-dimensional images known as visual-spatial imagery; and the visual cortex which is a section at the back of the brain responsible for piecing together the dream content from signals in our brain. Other areas of the cerebral cortex are deactivated during REM, including parts of the frontal lobes - the logical area of the brain. The dorsolateral prefrontal cortex is one of those parts and is responsible for controlling cognitive functions like evaluating and reasoning. Thus, the different parts of the brain activated during dreams explain why dreams are visually seen, illogical, yet strongly emotional.

As a side note, studies show that how much we remember our dreams depend on the wavelengths in our frontal lobe. People remember most about their dreams if awakened right after REM because people experience lower frequency waves in the frontal lobes - which control cognitive functions - after REM. These low-frequency frontal theta waves are similar to those observed when recalling memories while conscious. The lower the frequency waves, the more likely you will remember your dreams.

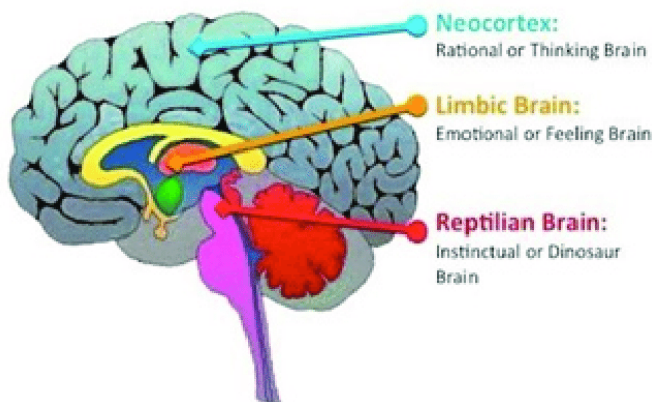
Why do we dream?

For decades people have attempted to discover the cause of dreams, and yet to this day only possible theories exist. There are two sides to answer the question - from the psychoanalytic approach which believes dreams serve a primary purpose, and the neuroscientific approach that doesn't. Firstly are the neuroscience approaches. The theories I will explore are the activation-synthesis hypothesis and the theory stating that dreams are a way to organise information.



The activation-synthesis theory is supported by three main points. Firstly, high levels of activity are needed for dreaming to happen in the brain because these high levels of activity cause REM sleep, when dreaming happens. Secondly, the high levels of activity are created by electrical impulses pulling out thoughts and images from memory, and when it does this the forebrain attempts to make sense out of those random signals of thoughts and images, creating the illogical content of dreams. Thirdly, the brain attempts to make sense out of those random signals because it naturally tries to make sense out of things, even if there is no sense in the data given to it. Although the science behind REM sleep supports this theory, it has been disproved because there has been dreaming detected in other parts of the cortex during Non-REM periods of sleep.

Another neuroscientific theory states that dreams organise information. Supposedly, while we sleep our brains sort through the information gained throughout the day. Research shows dreaming to be either a by-product of the processing of information or perhaps even a part of the sorting through of information and data. A study by Max Planck Medical Institute supports this theory. Results gathered from the study showed that the neocortex in mice signals the hippocampus to transfer the short term memories stored there so that the storage can store more information the next day. Once transferred to the neocortex, the neocortex decides whether to discard the short term memories or keep them as long term memory. As the data is being transferred, the theory goes, bits of it are mixed to form dreams, making up a rough resemblance of your real-life experiences.



Secondly are the psychoanalytic theories, which consists of the most popular threat simulation theory, as well as other theories believing that dreams act as a form of therapy, an expression of desire, and a way of problem-solving. The threat simulation theory states that dreaming is a defence system inside us that acts as something like a fire drill to prepare us for possible threats in real life, also helping people become more aware of and more able to avoid threats. This theory works better for people from ancient times because people then had limited knowledge about the threats they would face, but nowadays we are a lot more prepared and cautioned. It also explains nightmares, which mostly happens during more intense parts of REM. The idea is that the brain scares people with nightmares, guiding their attention to possibly dangerous things in real life. Branching from this, post-traumatic nightmares, a type of nightmare that occurs in people with PTSD, happens because of the oversensitiveness of fear-involved brain sections like the amygdala, which detects threats. Post-traumatic nightmares are assumed by scientists to be equivalent to anxiety reactions, as well as flashbacks people experience when awake.

The theory of dreams having therapeutic purposes is based on the idea that dreams help us process emotions by turning them into memories while we sleep, removing them from their original experiences. This way, our emotions, especially the negative ones, won't build up to anxieties and worries. This theory suggests that even if the content of our dreams is not real, the emotions in them are. The science behind it comes from studies of REM sleep, which proved that not having enough REM sleep leads to the development of mental disorders like anxiety and depression. This supports the theory because most dreaming happens during REM, and without dreams, we won't be able to sort through our emotions. Another way of proving the therapeutic theory is through first-hand experiences. As many probably already know, dreams are emotionally intense. This - the theory would explain - is because those dreams are composed of emotions we experienced and are now being made into memories we see as dreams in our sleep.



The third psychiatric theory I will explore believes that dreams are an expression of hidden desires, as well as unfulfilled wishes that, when awake, are kept hidden. Therefore they find their own way to be fulfilled through dreams. This theory believes that dreams are composed of two main things: manifest content like images that are tangible, and latent content - the hidden message behind dreams. It also believes in the interpretation of dreams to find the meaning behind it.

Although not among the most popular theories out there, the theory believing that dreams serve as a way of problem-solving is also a possible theory. As stated by it, dreams have evolved into extra thinking time as this is useful for humans, and this time is therefore used to help us solve problems. The thinking time is, however, more visual and random than normal thinking, so we adapt by solving “visual problems” while dreaming. A benefit from this is that the thinking time during dreams is beneficial for “out of the box” thinking that we find harder to achieve when awake.

Special cases

There are special cases when it comes to dreaming, yet not all of them are necessarily negative. Firstly is lucid dreaming, which in simple terms is when you know that you are dreaming inside a dream. The amount of control during a lucid dream varies with the dreamer, with some only knowing that they are dreaming and others having the ability to control what happens in the dream. Lucid dreaming is a state between REM and consciousness. Studies show that it happens because of “an increase of activity in the frontal lobes”, increasing the logical functions in our brain, though the reasons for that are currently unknown.

The second case is sleep paralysis - the opposite of lucid dreaming. This is when you are awake but cannot move because your body is still in REM state. Sleep paralysis, like lucid dreaming, occurs when a person is in between being awake and asleep and is caused either by your body's inability to smoothly go through the five stages of sleep, or disruptions in your sleeping patterns. The two types of sleep paralysis are hypnagogic sleep paralysis, which occurs during sleep, and hypnopompic sleep paralysis, which occurs during consciousness. The former is not obvious because people aren't awake for it. The latter, however, can happen with the feeling of pressure or even choking.

Thirdly is sleepwalking. Normally people don't act out their dreams because when impulses from the brain reach the muscles, chemicals are not released to make the muscles move. Some people who have disorders that stop them from achieving a complete REM state would still have produced chemicals that make the muscles move, making them act out their dreams.

Conclusion

Science has given us a huge boost in understanding dreams, bringing us a long way from the fragile theories we had during the earlier decades. However, some huge questions remain unanswered, and among them, the purpose of dreams is one of the most intriguing fuels for our curiosity. Why do dreams exist? What is their purpose? Do they have a purpose? Perhaps the answer lies among the fields of science and psychology, and it might just be closer than you think.

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The background of the cover features a close-up photograph of laboratory glassware, including a graduated cylinder and beakers, partially obscured by a solid purple rectangular overlay. The text is positioned to the right of this overlay.

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