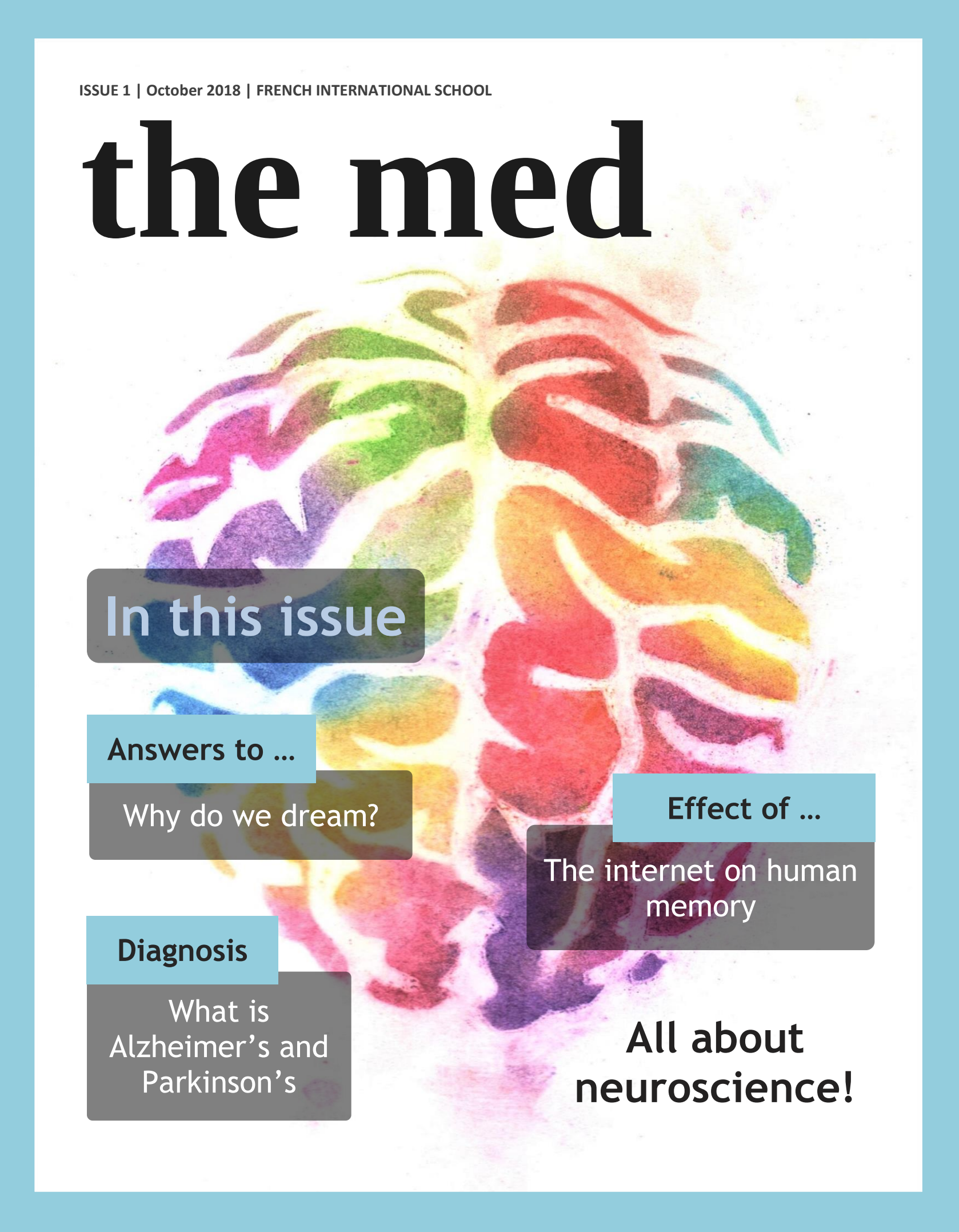
ISSUE 1 | October 2018 | FRENCH INTERNATIONAL SCHOOL

the med



In this issue

Answers to …

Why do we dream?

Effect of …

The internet on human memory

Diagnosis

What is Alzheimer's and Parkinson's

All about neuroscience!


THE
MED

EDITOR'S NOTE

Dear Medical Journal Readers,

If you're new, thanks for checking us out and if you're not, well then welcome back to the FIS Med Journal.

In this issue we would like to introduce the new team for the Med Journal. We are seven incredibly hard-working Year 12 students and to put a face to our names check us out on the 'The Team' page. We would also like to thank everyone for their fantastic work and contribution to this issue of the Med Journal, our year's first ever. To reflect this, we thought it would be appropriate to number this as issue 1.

Of course, as a united team of Year 12 students, the FIS Med Journal aims to provide a light-hearted magazine-style medical journal for all FIS students. We wish to create opportunities for research and collaboration and to raise awareness of medical issues within the FIS community. We also hope to spark inspiration and interest in younger students and to provide Medical School guidance and advice.

In this issue we are focussing on the medical field of neuroscience which we need to recognise for its importance in helping us understanding how our brain and body respond to various influences. On page 6 we delve into 'Addiction on the brain' and page 9 we discuss the effect the internet has on our memory. Have you have ever wondered why we dream? Well, on page 3 you will find the answers. Along with these we have an incredible line-up of other articles and a commentary to keep your brain energised as well as some mind-boggling diagnoses on Alzheimer's and Parkinson's. Remember to check out the FIS survey on Internet addiction as you might be surprised by the results. Finally, we showcase an informative piece for the 'University Guidance' section on the different teachings of medicine.

However, before you jump in we would just like to quickly thank the Year 11 and 13s for all their great work and editorial help on this issue, as well as Hadrian Wong for the smooth and seamless handover. We thank you all!

Anyway, have a good read and see you for the next issue!

Archibald Davies and Robin Lacoste

PREFACE

Neuroscience

BY MR CLAYTON

So, let's start this edition with a short quiz. It's a simple true of false quiz. So here we go.

Question 1- Humans only use 10% of their brains.
Question 2 Women are generally better at multi-tasking.
Question 3 The internet is making us dumber.
Question 4 Regular exercise actually improves school grades.
Question 5 There are different ways of learning like visual, auditory and kinaesthetic

Read on to see if you are a neuro master or not!

Neuro science has been through a revolution in the last 5-10 years mainly due to the development of magnetic resonance imaging which can basically 'see' what's going on in the brain without having to open up a patient's brain which is generally a good thing! A hugely enduring myth is that we only use 10% of our brains. This has been the subject of many movies like Lucy which implies that we have 90% of our brains lying dormant. Nothing could be further from the truth. It is true that we don't use all of our brains all the time but the idea that if we could only harness the missing 90% we would become super human is Hollywood myth.

You know the scenario-women are excellent at multi-tasking. They can make a call, order lunch, apply their make-up, prepare a meal and close a deal all at the same time! Men on the other hand are slow and laborious at anything, concentrating on one thing at a time, often unable to even walk and talk at the same time! True or not?!

So sorry to burst your bubble ladies, there is no such thing as true multi-tasking, it does not exist. None of us can perform two different cognitive processes simultaneously. Mental tasks which feel like they are being done in parallel are in

fact sequential. When our brains switch from one task to another we suffer cognitive loss. It appears that in general they may be better at minimising the cognitive loss associated with each switch in task.

So how about the internet? It's making us dumber right? Smart phones and dumb people? Columbia University has identified the so-called 'Google effect.' They discovered that students remember information better if they think that this information is not likely to be available on the internet. The study also showed that students are better able to remember where to find something on the internet rather than the remembering the information itself. The Google search engine is acting as an external memory. Some neuroscientists argue that the internet, social media and the like is rewiring our brains, and not in a good way!

Steven Pinker has argued that we are now making better use of our brains by using Google to store and access unnecessary information. We certainly know more than we did in the past, though there is an interesting argument that the Victorians were cleverer than us-debatable! Two leading neurologists conclude, 'We will no more lose our ability to pay attention than we will lose our ability to listen, see or speak.'

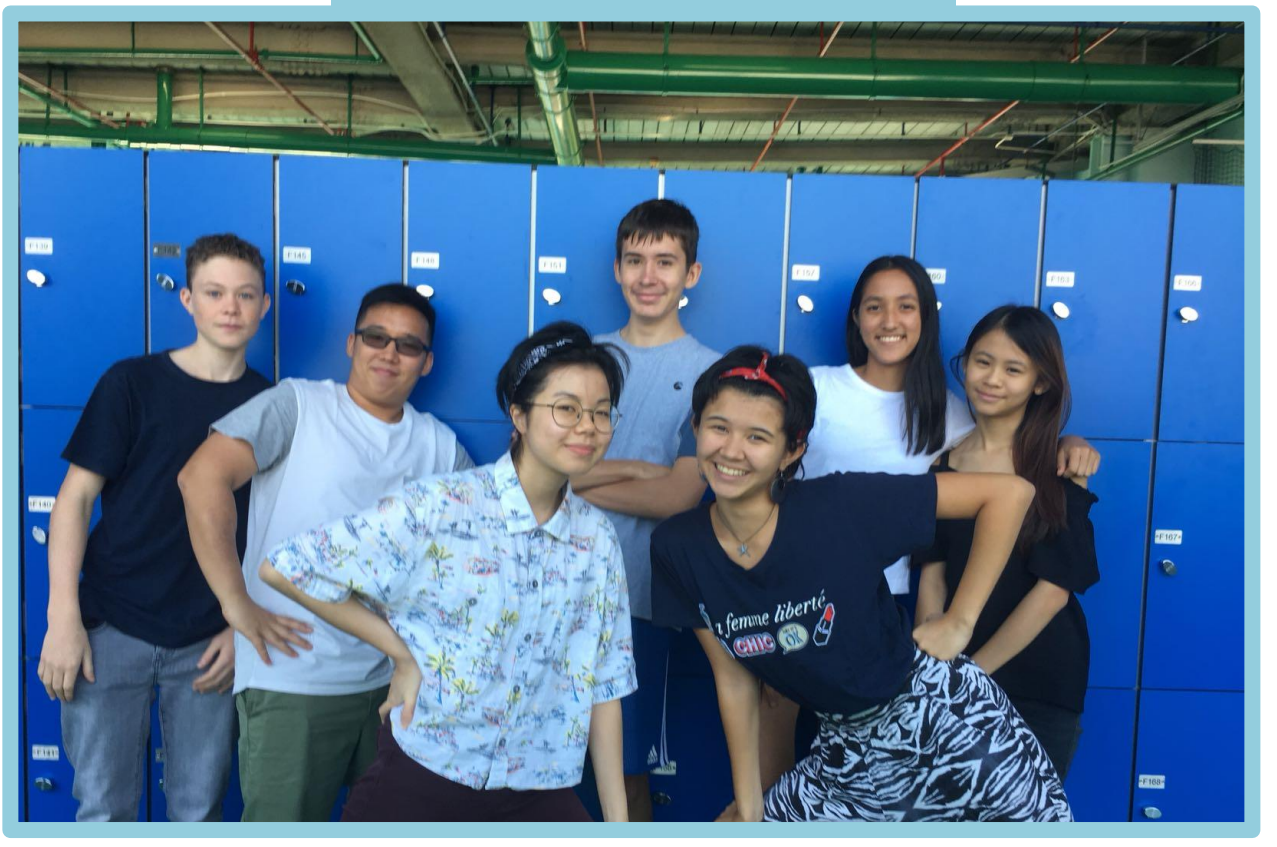
Now the question of exercise. Research shows that exercise has a massively positive impact on grades and outcomes. It appears that there is a sweet spot is just after exercise when the brain is at its most receptive. (Wipe the sweat away!) Our brains have been relatively slow to evolve, and they are still designed for the savannah and walking at least 12 miles a day. Exercise for our brains is crucial and in fact leads to discernible improvements.

Now the final one-the VAK effect. It is argued that some people learn better in a visual way, an auditory way or a kinaesthetic (movement) way. There is absolutely no evidence or research to back up this claim. In some studies, over 90% of educators still believe this myth. In fact, it is great to have multi-sensory inputs when learning new information, but vision trumps all other senses.

So, in conclusion the brain is endlessly fascinating made all the more interesting because we all have one! Let's finish on a high point, shall we? What do you call a skull without 1 billion neurons? It's a no brainer! Enjoy this issue!

THE TEAM

BEHIND THE MED



Top row (from left to right):

Archibald Davies – *Editor*

Matthew Chau – *Lead Artist*

Robin Lacoste - *Editor*

Emilie Parlett - *Co-Editor*

Mayumi Wong - *Co-Editor*

Bottom row:

Jenny Kam - *Co-Editor*

Audrey Corno - *Co-Editor*

Mrs Relan - *Teacher Supervisor*

Hadrian Wong – *Student Consultant*

OCTOBER 2018

the med

What's the Deal With

Featured Articles

Diagnosis of the Month

FIS Community Survey

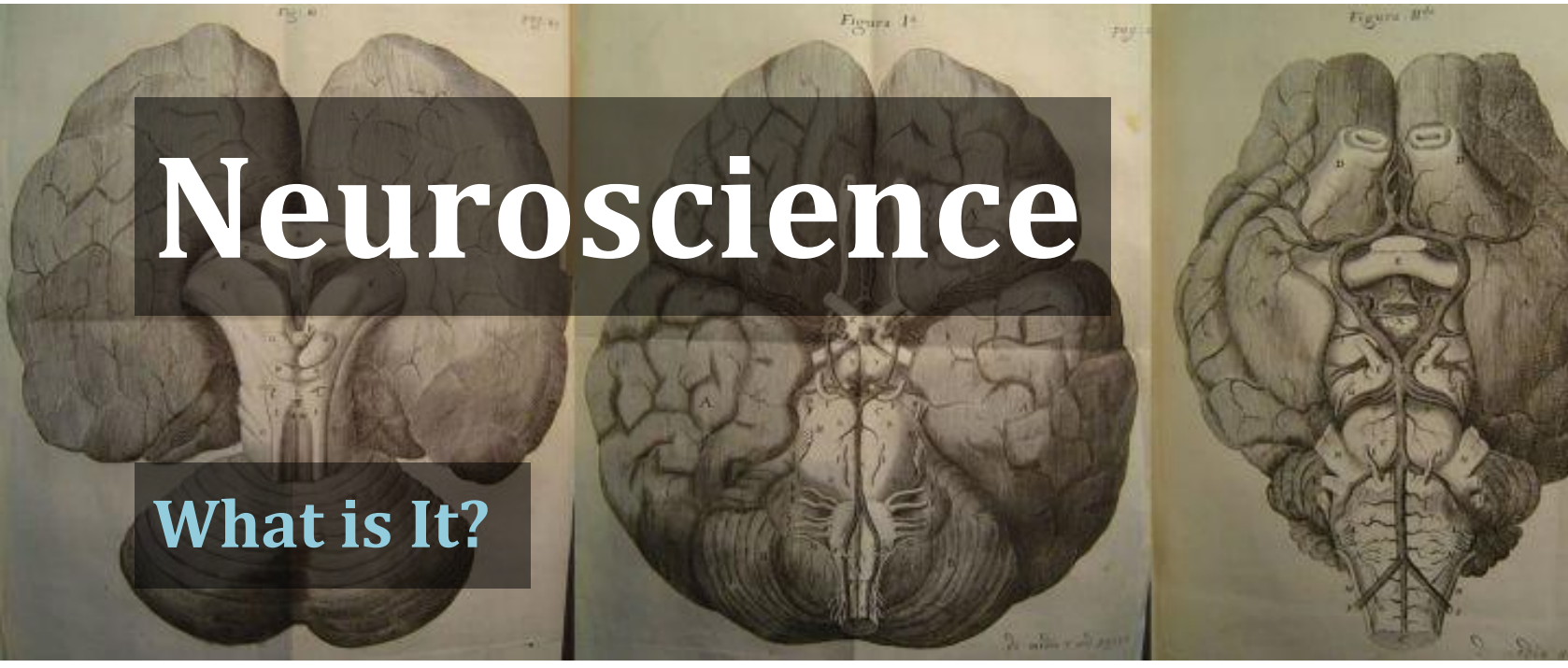
University Guidance

ON THE COVER:

Neurology artwork by Matthew Chau (Year 12)


THE
MED

WHAT'S THE DEAL WITH



Neuroscience

What is It?

By Maxine den Hartog (Y13)

In a nutshell, neuroscience explains your everyday actions, decisions, and behaviour with a deeper molecular understanding. This can range from why you decided to have toast for breakfast instead of cereal, or why you chose to binge that new show on Netflix, but it can be applied to many more complex behavioural conditions. Neuroscience is the application of many different areas of science in order to understand the structure and the function of the nervous system and the brain. The brain can be considered one of the greatest frontiers in modern science, the full understanding as to why we behave the way we do has become more and more popular and developed areas of science, but that which is still being researched due to its complex working. For those of you that like the more morbid and dark sides of life, it also looks into the reasons for psychiatric and neurological illnesses such as schizophrenia. The effects of these illnesses breech not only the human body but have a large impact on the socio-economic and clinical health of society. Therefore, by breaking down these behaviours or conditions into the numerous different scientific fields, we are able to understand the inner workings of the organ that holds authority in our everyday decisions.

Molecular and Cellular Neuroscience

This sub discipline of neuroscience is one of the fastest-growing and newest fields of neuroscience. Concerning the brain function and development, scientists in this field will aim to look at genes, signalling molecules and cellular morphology in order to have a better grasp at how our brain develops over time. Furthermore, it looks into the cause and effects of pathological conditions such as obsessive-compulsive disorder.

Neural Circuits and Systems

This sub discipline of neuroscience looks into the biological networks and neural circuits in terms of how they are formed, therefore, the mechanisms by which behaviours are created. By using anatomy and physiology, neuroscientists are able to decipher how processes such as memory, emotional function and reflexed come about.

Cognitive and Behavioural Neuroscience

Arguably the most ambiguous and morbidly fascinating, cognitive and behavioural neuroscience looks into the mental and behavioural processes through different psychological disciplines. This includes the entire brain contribution or simply just mental processes. Cognitive and behavioural neuroscience is an obscure branch of neuroscience yet encompasses things that we see every day including stress, anxiety and depression.

FEATURED ARTICLE 1

Why do we dream?

BY AUDREY CORNO (Y12)

Despite the extensive research on the subject, scientists struggle to find the purpose of dreaming. Investigations yield few quantitative results that can form solid evidence and conclusions. However, this isn't to say that we don't know anything about dreaming; here's what we do know, and what we don't.

Quick facts on dreaming

- We dream 3 - 6 times per night, lasting 5 - 20 minutes each
- 95% of dreams are forgotten by the time a person gets out of bed
- Blind people have been shown to dream more with other sensory components compared to sighted people - but can have visual dreams too
- You can't read or tell time during a dream
- The sewing machine, the periodic table, the DNA's double helix spiral form and Google were inventions all inspired by dreams
- Proven that every face we see in a dream is one we have seen in real life. A study of 320 adult dream reports found:

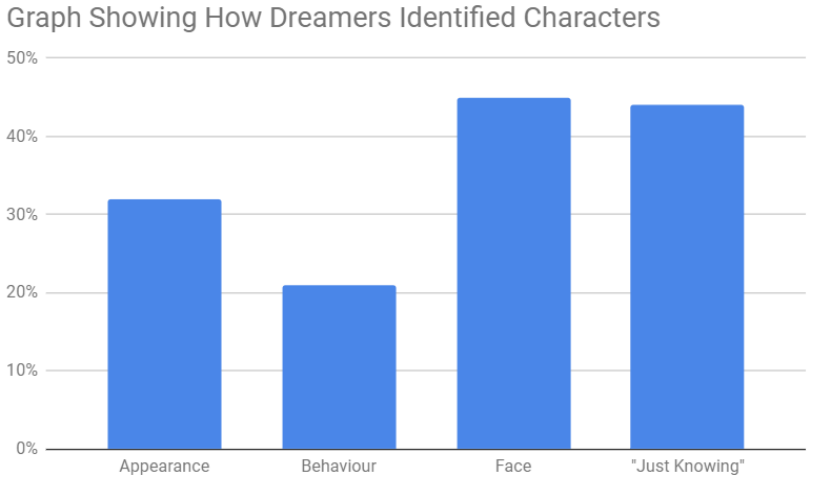


Fig. 1

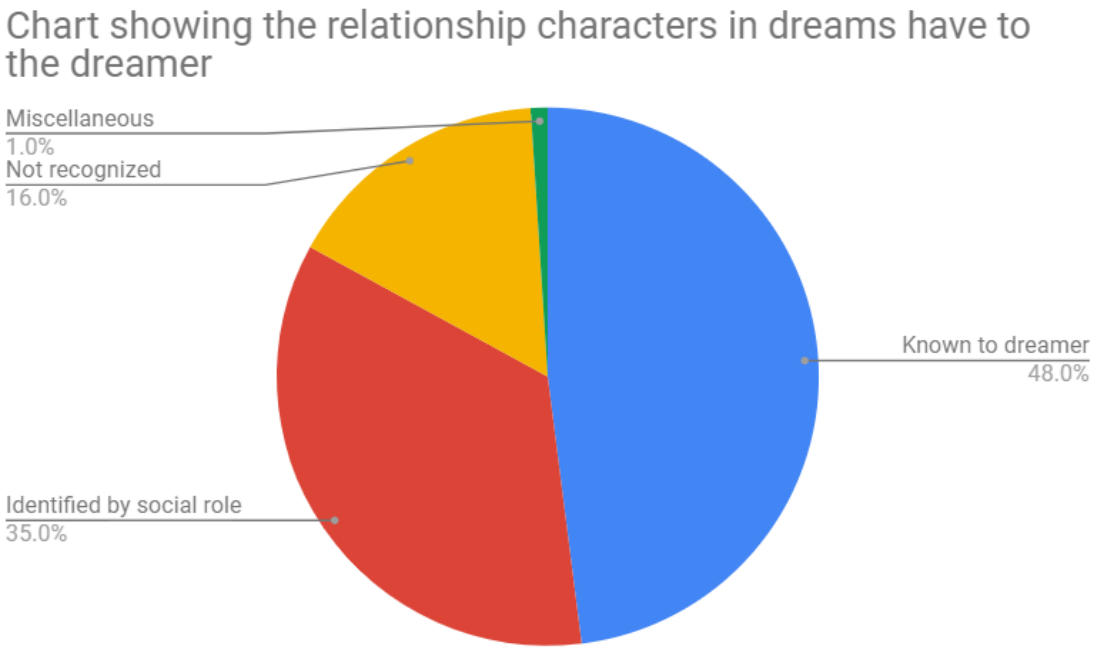


Fig. 2

- 70% of characters in a man's dream are other men, but women's dreams contain an equal amount of men and women
- Around 12% of people dream in black and white

Stages of sleep

1. Light sleep, slow eye movement, reduced muscle activity; 4 - 5 % of total sleep
2. Eye movement stops and brain waves become slower, occasional bursts of rapid waves; 45 - 55% of total sleep
3. Extremely slow brain waves interspersed with smaller, faster wave; 4 - 6% of total sleep
4. Only extremely slow brain waves (deep sleep); no eye movement or muscle activity, very difficult to wake someone; often feel groggy and disoriented if woken up in this stage
5. Rapid Eye Movement; breathing becomes rapid, irregular and shallow, eyes jerk rapidly in various directions, limb muscles temporarily paralysed. Heart rate increases, blood pressure rises. **This is where most dreaming occurs.** 20 - 25% of total sleep time.

Fundamentally, we don't know the exact function of dreaming, since we don't know the function of REM (rapid eye movement). This doubt brews speculation and the following theories have been put forward.

A prominent theory is that of the "Contemporary Theory of Dreaming". This states that activation patterns (the electric stimuli that cause memory) constantly shift, therefore making and destroying memories. There is a spectrum in how these memories are made; one end concerns things like math and linear concepts, and one end to do with daydreaming, philosophical concepts, etc. Dreaming is supposedly guided by the emotions of the dreamer; for example, if they had recently gone through a traumatic event, like rape or escaping a burning building, they wouldn't necessarily relive that event in their sleep. Instead, they'd dream about being at a beautiful beach only to be drowned by a tidal wave, which is simply a representation of their emotions. When one's emotional state is less clear, dreams become more complicated due to the conflicting emotions and thoughts - studies have shown that people who have recently suffered a traumatic event have more intense dreams (the intensity of the

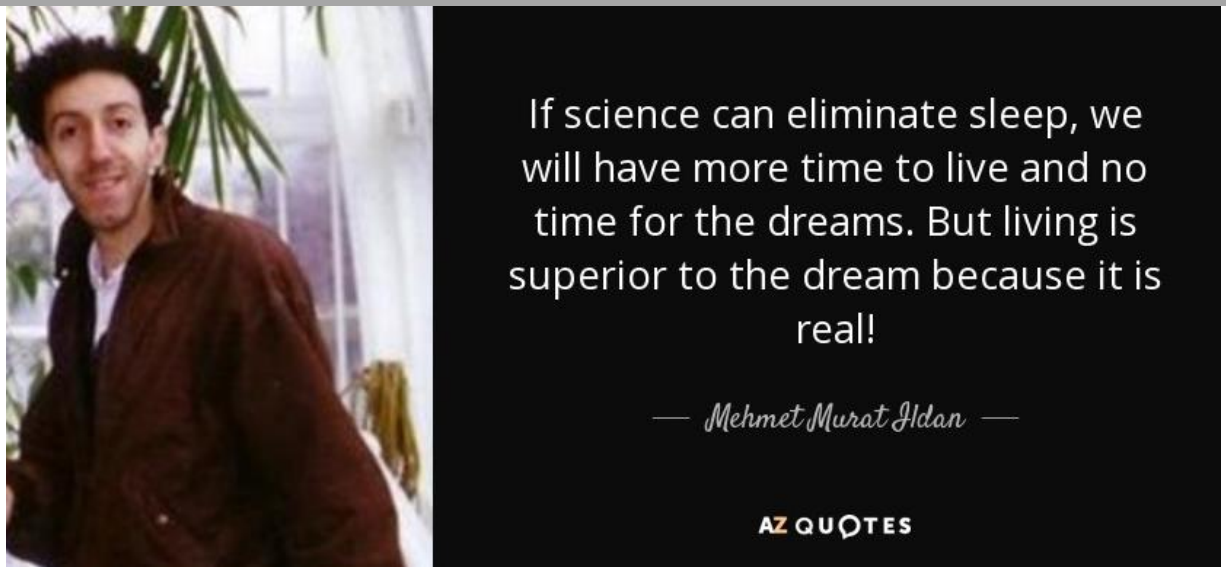
dream can be measured by the emotional arousal of the subject, quantified by brain activity. Dreams are considered to be almost a form of therapy where people visualize their emotions over and over again to make them less disturbing and eventually recover from their trauma. One study, where subjects were woken up right before REM and weren't allowed to dream, experienced increased tension, anxiety, depression, difficulty concentrating, lack of coordination, weight gain and a tendency to hallucinate. This could, however, have to do with not sleeping enough in general, where symptoms are very similar, instead of dreaming specifically. We dream to reduce emotional arousal and deal with stressful events, which is necessary for mental and physical wellbeing. Though this isn't proven, this theory is potentially true.

Another theory is that dreams work hand in hand with sleep to help the brain sort through everything it collects during waking hours. During sleep, it is agreed that the brain sorts through the information and decides what's relevant or not to keep in memory; dreaming is believed to play a role in this process. One study showed that the subjects taking a language course showed more dream activity to those who weren't; because of this, the idea that sleep converts short-term memories to long-term memories has gained credibility.

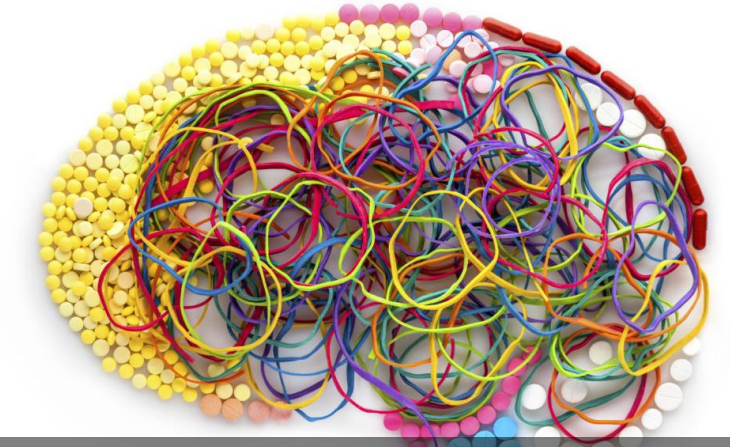
An idea that originated from Freud is that dreams can ease the repression of undesirable memories. A study showed that sleep does not help people forget unwanted memories but actually improves the memory and makes them more accessible for retrieval. Another study had 15 good sleepers suppress an unwanted thought for 5 minutes before sleep, and the results showed that there was a tendency to have more distressing dreams about those repressed thoughts. This is where the theory that unconscious thoughts and desires surfaced in dreams comes from.

Other theories that have less evidence supporting them state that dreams help individuals prepare for possible future threats or develop cognitive capabilities; another one is that sleep has **no** function, that it's a side product of REM and is interpreting random signals from the brain and body into visual images during sleep.

So, which one is it? Are all of these functions valid? Are none of them valid? Only time (and dreaming) will tell.



FEATURED ARTICLE 2



Addiction and the Brain

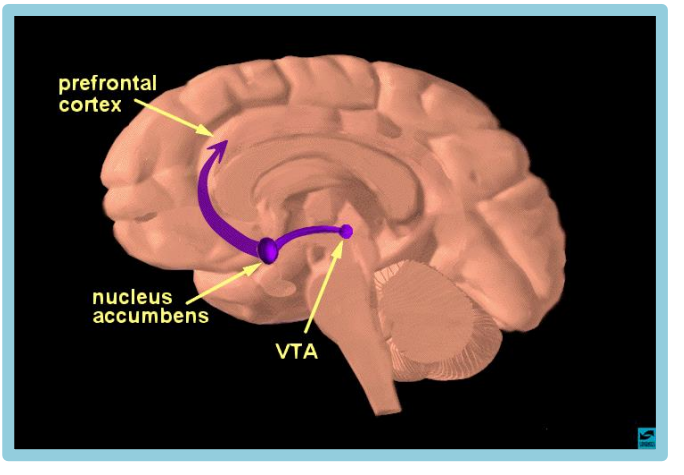
BY MADHAVI CHAKRAVORTY (Y10)

Drug addiction is considered as a chronic disease

For a long time, people addicted to drugs were judged as morally flawed people lacking willpower. However, in the 1970s, experiments conducted on rats led scientists to discover that drugs interfered with the functions of certain areas of the brain and caused long-term harmful consequences. Today, addiction is considered as “a chronic, relapsing brain disease.”

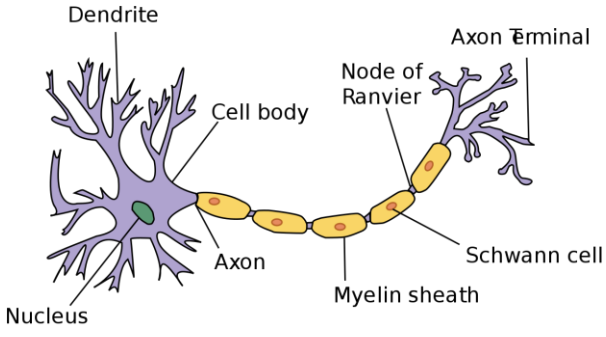
The Reward Circuit

Scientists discovered that drug addiction centers around chemical alterations in a single pathway within the brain called the “reward” circuit (see diagram on the right). The reward circuit includes parts of the brain located above the brainstem in the limbic system such as the ventral tegmental area (VTA) and the nucleus accumbent. The activation of the reward circuit is an essential spur to motivation, an incentive to learn and repeat adaptive behaviour. It is associated with euphoria and pleasure. The prefrontal cortex (involved in decision making, planning and personality expression), hippocampus (involved in long-term memory) and amygdalae (involved in emotions and survival instincts) are also affected by the reward circuit.



Neurons and Neurotransmitters

Now that we know the areas of the brain that are affected by drugs let us discuss the cellular mechanism through which drug effects are transmitted. Neurons are brain cells that transmit the electrical and chemical signals that allow us to function. The neuron is an elongated cell (see diagram on the right). It has many branches called dendrites that approach other adjacent neurons. It has a long extension called an axon through which the signals are transmitted. At the end of the axon is a "terminal button". The terminal button has chemical transmitters and receptors. The adjacent neuron is separated by a small empty space called a synapse. When a signal is transmitted, the terminal button of the axon releases chemicals called neurotransmitters at the synapse which are received by the adjacent neurons and passed on. Each neurotransmitter tells the adjacent neuron to carry out a specific task. Some common neurotransmitters are shown in the table to the right.

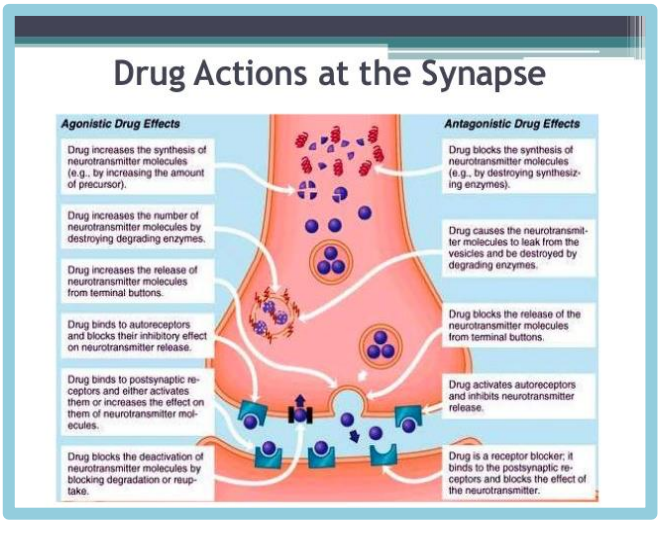


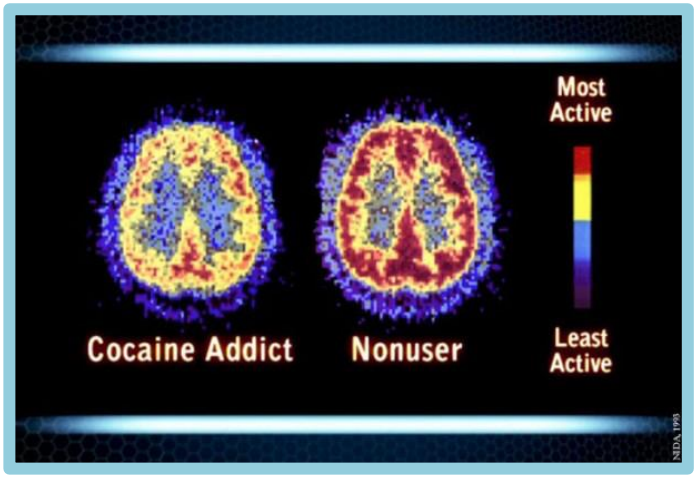
Common Neurotransmitters

Neurotransmitter	Drugs Affecting It	Functions
Dopamine	Every drug	Reward, punishment, pleasure, energy
Serotonin	Stimulants	Arousal, alertness
GABA	Depressants, Marijuana	Arousal, judgement, impulsiveness
Endorphins	Opioids, Depressants	Pain relief, reward, punishment
Acetylcholine	Hallucinogens	Movement, memory, motivation, sleep

How Does Addiction Develop?

Scientists discovered that drugs interfere with the neurotransmitters, in particular a neurotransmitter called **dopamine**. Some drugs, called agonistic drugs, increase the production of neurotransmitters or interfere with the reuptake of neurotransmitters. On the other hand, antagonistic drugs decrease the production of neurotransmitters and block the receptors (see the diagram in the bottom left). Over time, the brain adjusts to the surges in dopamine or other transmitters. by producing less dopamine or by reducing the number of receptors. This results in lower dopamine levels, which causes painful mental states such as listlessness and depression. Now the person needs to keep taking drugs again and again to restore the dopamine supply to normal levels which makes the problem worse like a vicious cycle. The brain looks distinctly different (see the scan picture to the bottom right).





Can Addiction Be Cured?

Addiction is a chronic disease and can be managed successfully. Due to its chronic nature, relapsing to drug abuse at some point during treatment is likely. Relapse rates are similar to those for other well-understood chronic medical illnesses (see chart below). For a person recovering from addiction, lapsing back to drug use indicates that addiction needs to be adjusted, or that another treatment should be tried.

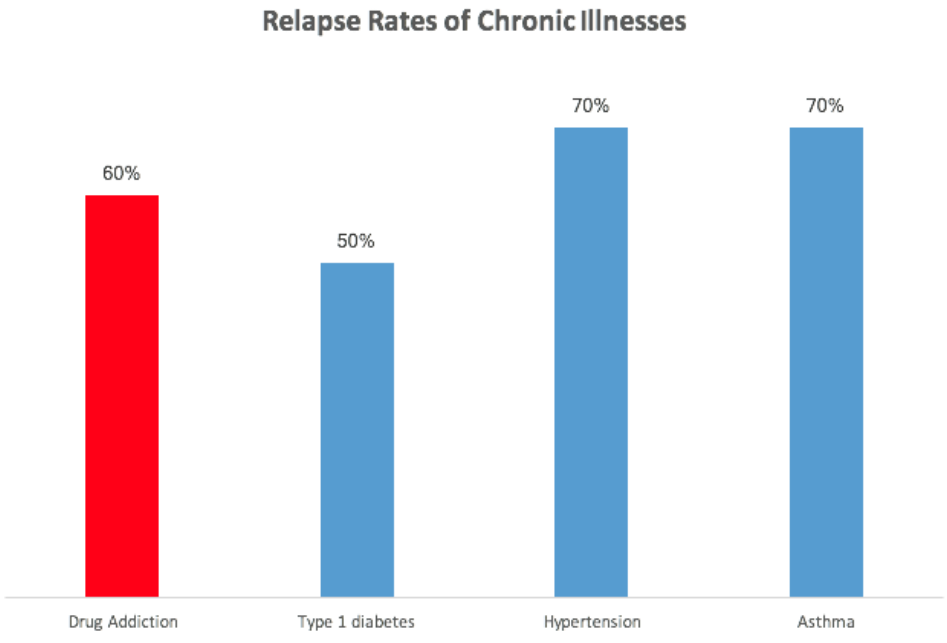
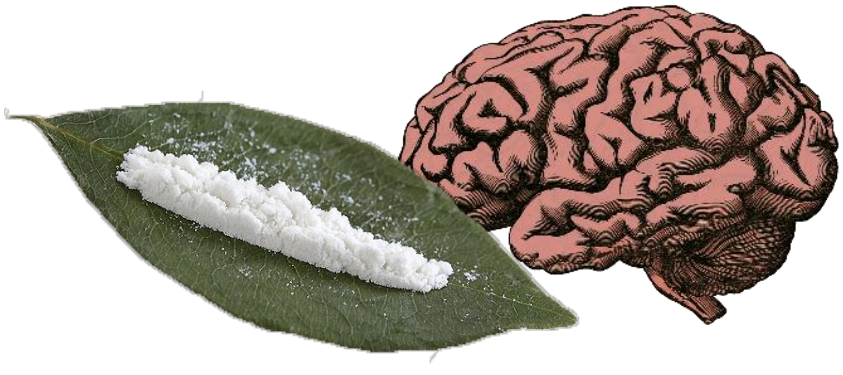


Fig. 1

Medications are often useful at different stages of treatment. Some examples include:
Addiction vaccines, which create antibodies generated to specific abuse drugs to bind the drug while it is still in the bloodstream, preventing it from entering the brain. This has been applied against nicotine and cocaine.

Long-lasting depot medications - such as vivitrol, which is prescribed for alcoholism, has shown spectacular results as opiate replacement therapy.
Medication combinations, which helps in tackling withdrawal symptoms that often prompt relapse. A combination of lafutidine (medication to treat hypertension) and dronabinol (the active ingredient in marijuana) has been successfully used to greatly reduce withdrawal symptoms in marijuana addiction.

We can conclude from this study that drug addiction is a chronic disease of the brain which is well understood and can be treated successfully over time. New approaches are being developed to make the treatments sustainable and reduce relapse rates, even as we write.



FEATURED ARTICLE 3

The Internet's Effect on Human Memory

BY SACHA LEE (Y13)

The Internet is a crucial component of modern-day living, it provides us with the ability to access knowledge with the click of a button at any point in the day. With phones and computers becoming a modern necessity, it begs the question: how is this affecting us on a neurological level?

The brain is a complex organ containing a multitude of components imperative for memory, processing information, movement, etc. Memory can be divided into three categories: short-term, long-term and working memory. In order to investigate the effect that the internet may have on the memory and cognitive abilities of adolescents, a study was conducted where students were given information, but were also told that they would have access to that information later on in the experiment.

> *"In 2011, Sparrow and colleagues tested how the expectation of having access to information at a later time affected the memory of undergraduate students. When expected to have future access to information, students were less likely to remember specific information but were more likely to remember where to find the specific information." (Trends in Cognitive Sciences)*

The results showed that those who assumed that they would have access to the information at a later time were less able to remember the information that they were shown. This can be associated directly with the effect of the internet on adolescents. Nowadays, everybody has access to all the information they want simply by accessing the internet so rational suggests it would be redundant to memorise that which is constantly accessible. This, however, will have a negative impact upon a person's memory recollection ability and possibly other cognitive functions orchestrated by the brain.

> *"Now, researchers from the University of California, Santa Cruz and University of Illinois, Urbana Champaign have found how an increased dependency on the internet impacts our problem-solving abilities, recall and learning." (International Business Times)*

People have developed an increasing dependency on the internet and the services that it provides: *"This phenomenon of relying on memory aides is known in the scientific community as cognitive offloading." (International Business Times)*

Statistics show that the average internet user spends 4 hours and 25 minutes online per day. This emphasises the reliance of our current population on the resources provided by the internet. Although this modern invention has undoubtedly drastically improved our efficiency as a whole, as it's mass usage is still a relatively recent development, the total extent to which this use may be affecting different components of the body is otherwise unknown.

An article published by the Los Angeles Times states that:

> *"[W]e've come to use our laptops, tablets and smartphones as a 'form of external or transactive memory, where information is stored collectively outside of ourselves. ... We are becoming symbiotic with our computer tools, growing into interconnected systems that remember less by knowing information than by knowing where information can be found."*

Although this use of electronic devices effectively as 'external memory' can be viewed as an evolution in the cognitive process conducted by humans, due to its major improvements in our efficiency to complete tasks and obtain information, this almost complete reliance on technology may not be beneficial: if say, for example, someone is placed in a situation where they are unable to gain access to any of these devices they may have lost the ability to recall any of the required information independent of the internet.

Therefore, we should question, even though the internet is an incredibly effective and useful resource, but at what price?

FEATURED ARTICLE 4

The Psychology Behind Rewards: The Reward Center of the Brain

BY HUGO WONG and AARMANN MOHAN (Y13)

The driving force behind why people would be motivated can be divided into three parts: primary, intrinsic and extrinsic motivation.

Primary motivation

Primary motivations are conditions that humans are innately driven to satisfy. It is the simplest, and most powerful form of motivation. Examples of primary motivation include hunger, thirst, sleep, sex, and avoidance of pain. Actions that satisfy these motivations, such as eating and drinking, produce dopamine: a neurotransmitter that elicits pleasure and drives desire.

These basic motivations are so powerful that it would be considered a disorder to not be driven by them. The main reason for this is best looked at from an evolutionary perspective: going against these motivations would be undesirable from an evolutionary standpoint because it would decrease one's chances of surviving or reproducing. Because there is more offspring from individuals who value these motivations, these motivations become stronger and more reinforced within the population. As more generations produce offspring, actions satisfying these motivations trigger more release of dopamine to make them more desirable. This is the effect of natural selection. It is also why humans share many of the same primary motivations with other animals: it makes sense to abide by these motivations from their evolutionary standpoint as well.

Intrinsic motivation

Intrinsic motivation refers to reasons to undertake activities because they are naturally satisfying to you. Examples of intrinsic motivation include curiosity, ambition, competition, control, and challenges. These motivations do not relate directly to survival or reproduction as opposed to primary motivations but are satisfied because they provide pleasure to some. Intrinsic motivations vary in abundance and intensity from person to person: for example, some people are more conscious and reliant on self-esteem than others. Animals also show intrinsic motivation, but some of these motivations may be more lacking in some animals than others and some animals may not show signs of specific intrinsic motivations.

Intrinsic motivations are less powerful than primary motivations but can be more or less powerful than extrinsic motivations, depending on the extent to which someone values an intrinsic motivation and the value of the reward in extrinsic motivation. It varies from extrinsic motivation in that the person desires intrinsic motivation without outside interference or factors (for example, intrinsic motivation can be when someone works hard to obtain a good grade on a test for their personal satisfaction, ambition, and self-esteem as opposed to extrinsic motivation when said person works for a good grade because their parents promised a materialistic reward.

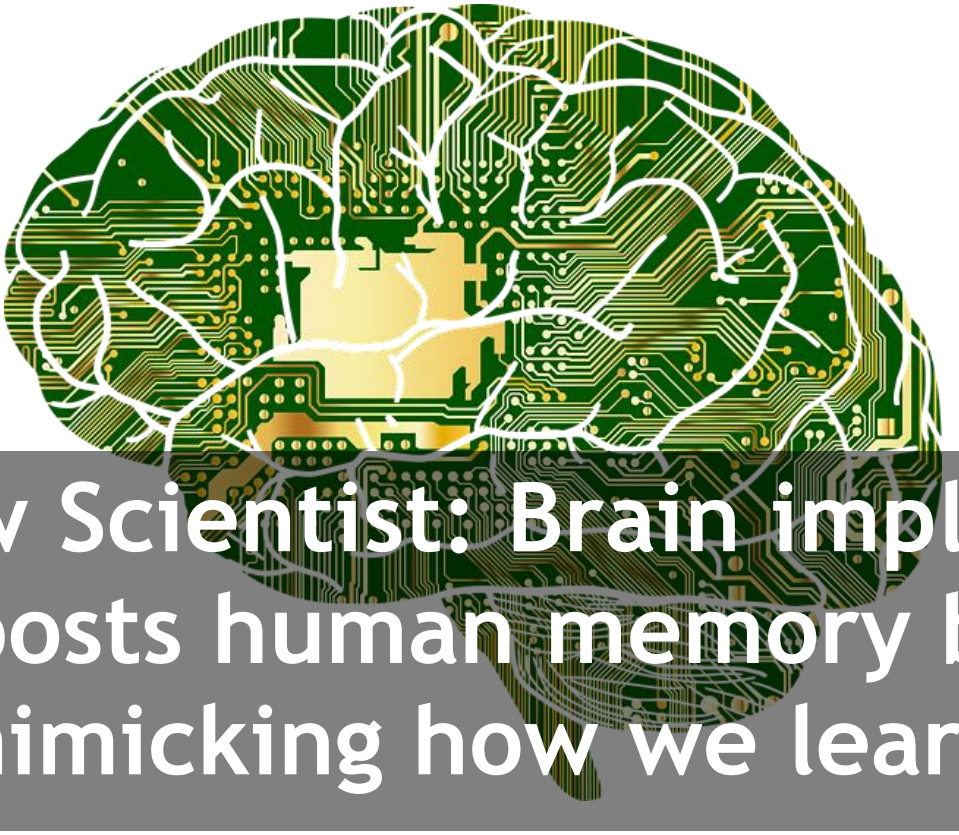
Intrinsic motivation is in general, stronger, cheaper and more reliable in the long run than extrinsic motivation. This is why many companies try to invoke self-motivational intent in employees rather than simply offering financial reward. This is not surprising as people work a lot harder to do something they desire as opposed to being told to do it. From an educational perspective, a good way to strengthen self-control and reduce procrastination would be to try to enjoy working by assigning a higher purpose to it, such as ambition or competition as opposed to giving yourself a materialistic reward.

Extrinsic motivation

Extrinsic motivation refers to behavior that is driven by external rewards such as money, fame, grades, and praise. This type of motivation arises from outside the individual, as opposed to intrinsic motivation, which originates inside of the individual. People who are extrinsically motivated will continue to perform an action even though the task might not be in and of itself rewarding. A person who works in a manufacturing position, for example, might perform a number of routine tasks that are not enjoyable. Because this person is receiving an extrinsic reward (a paycheck) for completing these tasks, he or she will feel motivated to perform them. The same applies to school, if we read an article online for example related to class material. It would most likely be extrinsic motivation as by reading that article, you are studying the material to gain external reinforcement (getting a good grade). However, if you were reading that article because you are interested in learning about the topic of that article, then that would be an example of intrinsic motivation.

So how well do extrinsic rewards work for increasing motivation? This type of motivation can be highly effective. Just look at all of the examples in your own life of things that you do in order to gain some type of external reward. For example, in exams, we study in order to get a good grade in school. This includes psychological forms of extrinsic motivation such as praise and public acclaim from teachers and/or parents. However, this time of motivation may backfire. Researchers state that offering excessive rewards can actually lead to a decrease in intrinsic motivation. This is known as the over justification effect which involves a decrease in intrinsically motivated behaviors after the behavior is extrinsically rewarded and the reinforcement is subsequently discontinued. So rather than taking actions (e.g. studying) for our own personal benefit in order to increase our own knowledges we often take actions in order to pursue and gain something personal in return for our actions.

Extrinsic rewards can be an important tool in motivating behavior, but experts caution that they should be used with caution, especially with children. Extrinsic motivators are best applied in situations where people have little initial interest in performing the activity or in cases where basic skills are lacking, but these rewards should be kept small and should be tied directly to performing a specific behavior. Once some intrinsic interest has been generated and some essential skills have been established, the external motivators should be slowly phased out.



New Scientist: Brain implant boosts human memory by mimicking how we learn

BY JESSICA HAMZELOU (Y13)

13 November 2017

A “memory prosthesis” brain implant has enhanced human memory for the first time. The device is comprised of electrodes implanted in the brain and is designed to mimic the way we naturally process memories and can boost performance on memory tests by up to 30 per cent. A similar approach may work for enhancing other brain skills, such as vision or movement, says the team behind the work.
“We are writing the neural code to enhance memory function,” says Dong Song of the University of Southern California, who presented the findings at the Society for Neuroscience meeting in Washington DC over the weekend. “This has never been done before.”

The team’s implant gives small electric shocks to the hippocampus, a brain region vital for learning and memory. By releasing bursts of electricity in a pattern that mimics normal, healthy brain activity patterns, it is hoped that the device will help with disorders involving memory problems, such as dementia, and even be adapted for other brain areas, to boost other types of brain function.
Song and his colleagues implanted their device in 20 volunteers who were having electrodes put into their brains anyway, to treat epilepsy.

First, the team used the device to collect data on patterns of activity in the brain when the people were learning. Each volunteer performed a memory test, in which they had to remember which unusual, blobby shapes they had been shown 5 to 10 seconds before. This test measures short-term memory, and people normally score around 80 per cent on this task.
They also did a more difficult version of the test, in which they had to remember images they had seen between 10 and 40 minutes ago. This measure working memory - the things we keep at the front of our minds while making decisions, for example.

Rerouting memory

The team used this data to work out the patterns of brain activity associated with each person's best memory performances. The group then made the device electrically stimulate similar brain activity in the volunteers while they did more memory tests.

A third of the time, the device stimulated the participants' brains in a way the team thought would be helpful. But a third of the time, it stimulated the brain with random patterns of electricity instead, while the remaining third of the time, it didn't stimulate the brain at all.

Memory performance improved by around 15 per cent in the short-term memory test and around 25 per cent in the working-memory test when the correct stimulation pattern was used, compared with no stimulation at all, says Song. Random stimulation worsened performance. It is the first time a device like this has been found to enhance an aspect of human cognition, says Song.

"It's exciting, pioneering work," says Sinead Mullally at Newcastle University, UK. "It is obviously a very early demonstration," she says. "But these are exciting results that are potentially quite important." Song hopes the device could help people with Alzheimer's and other dementias. "In those disorders, there is a lot of cell death in the hippocampal region," says Song, who thinks a memory prosthesis could bypass damaged areas. "That should reinstate and restore cognitive function."

The brain's hippocampus is particularly vulnerable to damage, whether from injuries or infections, says Mullally, who works with people with hippocampal damage. Theoretically, a device that bypasses regions of the hippocampus could provide a much-needed treatment, although the risks would have to be considered first, says Mullally.

Enhanced skills

Chris Bird of the University of Sussex, UK, agrees that such a device may be useful for treating medical conditions. But he says the prosthesis wouldn't be able to replace the hippocampus altogether. "The hippocampus is quite a large structure and they are only recording from a very small area," he says. "It's like dipping a bucket in a swimming pool."

The team is now working on ways to enhance other brain functions. "The approach is very general," says Song. "If you can improve the input/output of one brain region, you could apply it to other brain regions."
Good candidates for this are skills that are localised to particular parts of the brain, such as sensation of the outside world, vision and how we move. Enhancing these functions might improve a person's hand-eye coordination, for example.

Cognitive functions like intelligence, however, are too complicated, because they involve many brain regions working together.

The team is also testing to see if the device can implant false memories. "For example, if we show a picture of a dog, is there a pattern associated with the dog that we can use to create a false memory of the dog?" says Song. "We've started working on that."

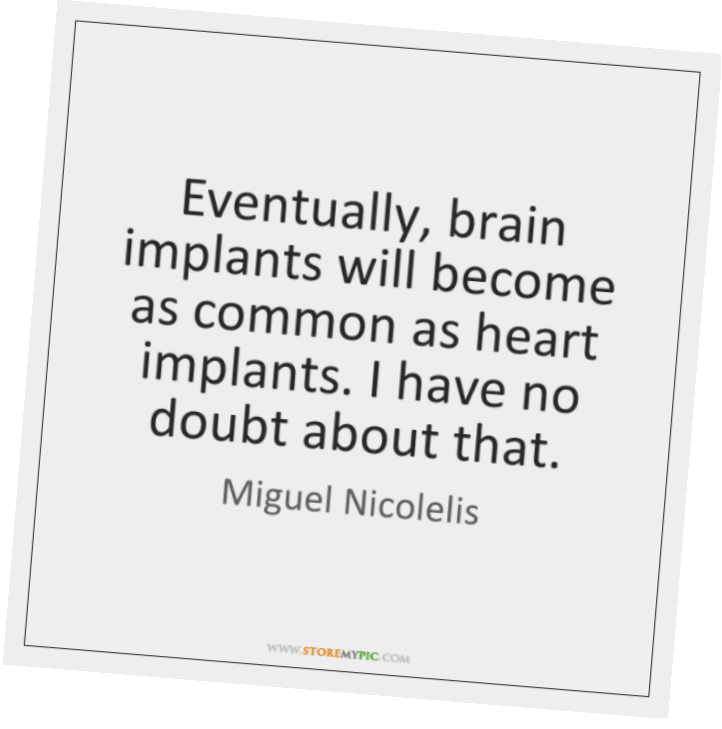
Commentary by Hadrian Wong (Year 13)

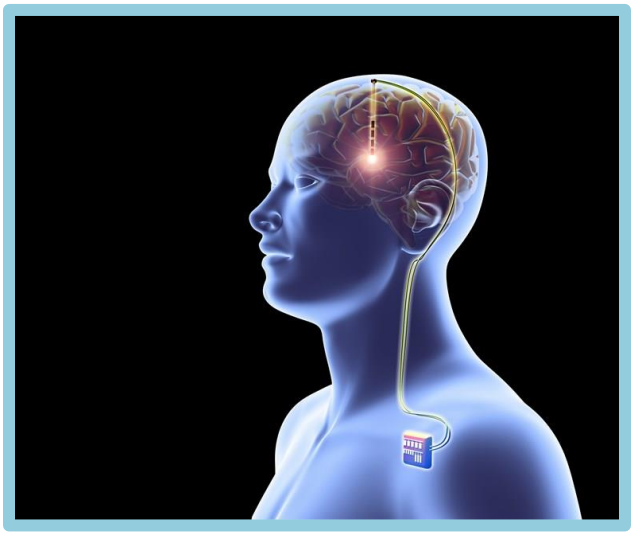
The ability to enhance memory is something that every student would desire in a perfect world. You could easily walk into a test confidently with little to no studying and for those teachers that can never remember a student's name, a product has been finally made for you! All kidding aside, what does this breakthrough really mean in the context of the medical industry as a whole?

The idea that your memory function would deteriorate is unthinkable, yet this is a condition that 46.8 million people worldwide would have to face on a daily basis. Dementia itself is not a disease, it is a general term for memory loss that is associated for many neurological diseases. It was mentioned in the article that the implant could potentially function as an enhancement for patients facing such issue. As of now, there is still no cure for dementia, yet there has been the use of prescribed drugs to lessen its effects for a limited time such as Exelon and Namenda. By surgically inserting an implant into the brain, it will end the dependence of drugs as a treatment and at the same time -as the implant would remain in the brain - it will provide relief for a longer duration unlike the drugs, therefore being more reliable as a treatment.

Yet a drawback for this implantation would be the fitness for surgery itself. As the prevalence of dementia is common with patients who are around 80 years old, this would limit those who are fit enough to undergo the implantation due to age. Would this mean that the implantation would only serve a small percentage of those who have dementia, or early onset of dementia? As of right now, little is known about the implantation process, or perhaps any advancements that would take place in the future.

Even though as of now there is little information about the finer details of the implant, the road ahead looks bright for the medical industry.





DIAGNOSIS OF THE MONTH

Alzheimer's Disease

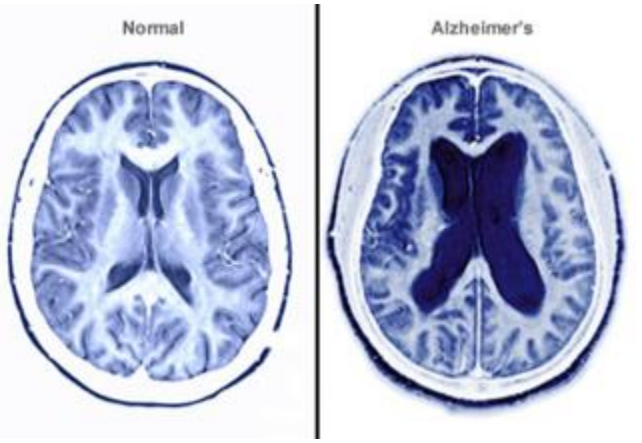
By Mayumi Wong (Y12)

What is it?

Alzheimer's is a progressive brain disorder - it is a common type of dementia. It is associated with the hippocampus in the brain, which is a region in the brain that is responsible for forming new memories. At the beginning of Alzheimer's, the patient's hippocampus begins to shrink, and neurons begin to die there - amyloid plaques (accumulated protein fragments in the brain that is not broken down) and neurofibrillary tangles (collapse of microtubule structure tubules due to abnormal protein) are thought to be causes of the degradation of neurons. Later on, as the disease progresses, the degradation of neurons slowly spreads throughout the brain and damages neurons in other regions of the brain as well. The degradation of nerve cells plays a huge role in Alzheimer's as it causes the loss of connection between neurons in the brain - which causes different kinds of symptoms with varying degrees of severity.

A visual representation of the difference between a healthy brain and a brain with severe Alzheimer's:

A PET scan which helps us visually compare the brain of a healthy person and the brain of someone who has Alzheimer's:



There are two forms of Alzheimer's

- Familial (caused mostly by genetics - due to a genetic mutation)
  - Rare
  - Has a very strong family link
  - Accounts for less than 1 percent of all Alzheimer's cases
  - Most severe
  - Develops in the early 40s

- Sporadic (caused by a combination of genes, environment and lifestyle)
    - Most common form Alzheimer's Disease
    - No family links
    - Accounts for 99 percent of all Alzheimer's cases
    - Develops in early 60s

Statistics

Alzheimer's is affecting a very large population in the world at the moment.

- According to the Centers for Disease Control and Prevention, Alzheimer's is the sixth most common cause of death among US adults.
- In 2017, about $259 billion was spent on Alzheimer's and dementia care cost in the US.

Causes

- Genes
  If someone in your family has Alzheimer's (i.e. parent or sibling), you're more likely (though it is not definite) to develop Alzheimer's (65 percent of people who develop Alzheimer's are from genetics).

- Age
  Your risk of developing Alzheimer's increases as you age.

- Down syndrome
  People with Down syndrome are more likely to develop Alzheimer's (and at a younger age).

- Lifestyle
  High cholesterol diet and lack of physical activity.

Cures

There is no cure for Alzheimer's at the present, but there is medication one could take to slow the progression of the disease. You could also change your lifestyle which might help in reducing the risk of developing Alzheimer's (read below, '*How to prevent Alzheimer's*' for this)

However, there is a lot of stem cell research going on, as stem cells are a potentially cure for Alzheimer's.

How to prevent Alzheimer's

1. Exercise
2. Balanced diet
3. Get enough sleep
4. Connect socially

Symptoms

1. Memory loss
    - Misplacing objects
    - Repeating statements over and over again, as they forgot that they have said it already
    - Forgetting names of friends and family

2. Difficulties in planning and solving problems
    - Concentration difficulties
    - Difficulty in multitasking

3. Confusion with time or place
    - They may get lost in familiar places from time to time

4. Problems with vocabulary
    - Have trouble expressing themselves, i.e. finding the right words to use in sentences

5. Decreased judgement
    - Difficulty in responding to problems we encounter everyday (making it more dangerous for them)

6. Changes in mood and personality
    - Mood swings
    - Social withdrawal

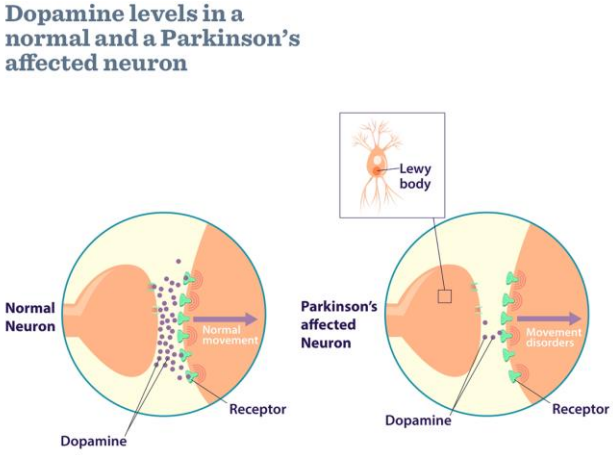
7. Inability to carry out certain tasks
    - e.g. cooking, playing games and even the inability to carry out basic tasks in advanced Alzheimer's

Parkinson's Disease

Jenny Kam (Y12)

Origin

Known as a neurodegenerative disorder, we commonly associate Parkinson's with older people, since Parkinson's occurs over time. The older one gets, the more likely one is susceptible to contracting it. Parkinson's disease is not infectious, occurring due to the fact neurons (or brain cells) in the brain stops the production of dopamine. Dopamine is a neurotransmitter – or a chemical released by the neurons to transmit signals, also being dubbed as the "happy chemical".



The discovery of Parkinson's can be traced as far back to the 1800's where it got its name. It was in the year of 1817 where the first clear medical description was written for it, namely by James Parkinson.

Initially his findings were deemed as "*paralysis agitans*", later being renamed by Jean-Martin Charcot as Parkinson's disease. In collecting vital information on Parkinson's, Parkinson described and observed six individuals who bore symptoms of the disease, distinguishing the difference between resting tremors (trembling) as well as tremors with motions.

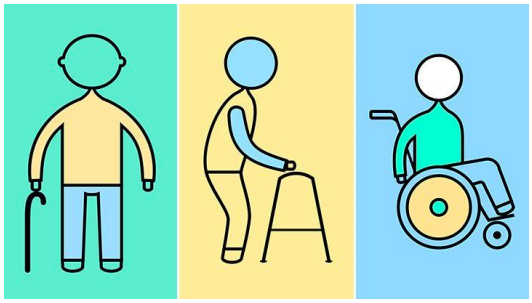
Those affected by Parkinson's develop certain symptoms directly linked to it, which occur gradually with time. With the unique nature of human beings, not all patients of Parkinson's will experience it differently on varying spectrums or intensities.

There are 1 million people worldwide who suffer from Parkinson's disease.

Symptoms

Often times, Parkinson's are characterized by:

- Muscle rigidity
- Tremors
- Difficulty in speech
- Problems with balance while walking

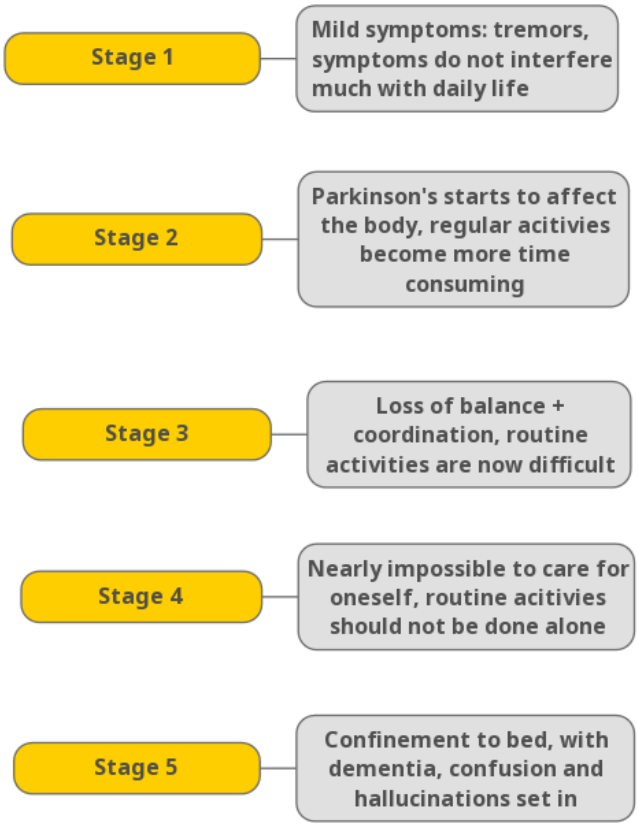


For example, a doctor might refer to using a scale to aid them in gaining understanding of the progression of someone with Parkinson's. The Hoehn and Yahr stages are simple, originating in 1967, widely used by clinicians, with the scale rating going from 1 to 5 and accounts for the motor symptoms. or movement symptoms.

The Unified Parkinson's Disease Rating Scale (or UPDRS) is more comprehensive, monitoring Parkinson's on a greater and in-depth level. This is due to the fact that UPDRS looks into one's non-motor symptoms, which involve the mental functioning, mood as well as level of social interaction.

Treatment

Unfortunately, there are no known cures for Parkinson's by far. However, many patients who suffer from Parkinson's are treated with alternative methods to combat the symptoms that come with it. There are certain medications that aim to treat and control symptoms of Parkinson's, especially with walking, movement and tremors.



Patients can take medication that increases or substitutes for the production of dopamine. A downside of Parkinson's medication is that despite its initially experienced effects significantly improve its symptoms, it will diminish over time, but symptoms should still be

controllable. Patients may also consider undergoing surgical procedures.

One of which, DBS stands for deep brain stimulation, involving the implantation of electrodes into a targeted region of the brain. Electrical pulses are sent towards the brain via the connection of electrodes implanted in the chest close to the collarbone. This helps to reduce the symptoms. DBS is often effective in stabilizing medication fluctuations, halting involuntary movement, reducing trembling, rigidity as well as the slowing of bodily movements.

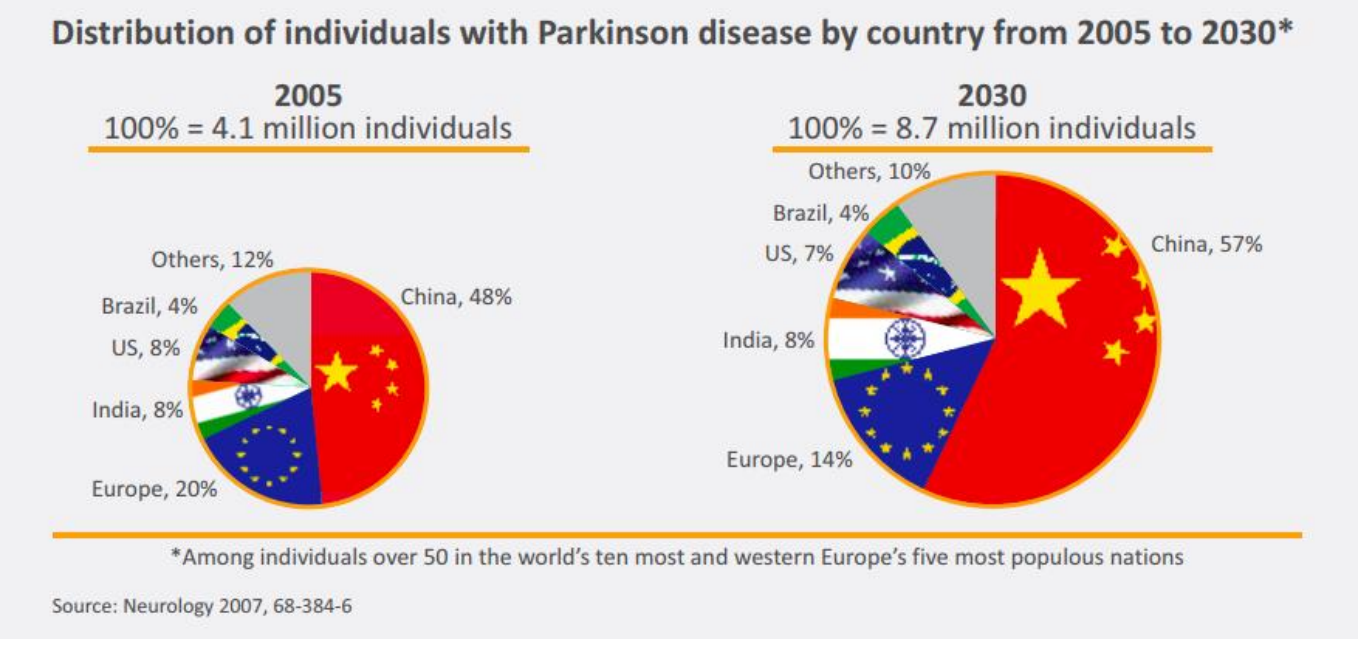
The pros of DBS are that its effectiveness in the reduction of erratic, fluctuating responses to levodopa (by far the most effective Parkinson's disease medication), which indicates that DBS can be used on patients who have unstable responses to levodopa. A con of this is that DBS does not aid to stop the progression of Parkinson's despite DBS' providing a sustained benefit for the symptoms.

It goes without saying that medical trials are not the only method in aiding with treating Parkinson's. People turn to supportive therapies, helping to ease certain symptoms experienced. In tandem with medical treatment, physical treatment can improve the quality of living for many. Massaging, tai chi, yoga employs the reduction of muscle pains and strengthening of them. Flexibility and balance are also improved this way.

For emotional health, having a pet that can be cared for can combat depression or stress experienced with low dopamine. Meditation can also help one to reflect and focus the mind's energies on a specific image, thus improving one's sense of well-being.

Statistics

Due to increased life expectancies, Parkinson's disease is expected to continue to grow, with the figure of 4.1 million to 4.6 million in 2005 will grow to be more than double in 2030, between 8.7 million and 9.3 million.



Based on collected statistics of worldwide cases, China currently stands at the highest number of patients with Parkinson's disease due to its high population. It is the second most age-related

neurodegenerative disorder, just behind Alzheimer's disease. Approximately 5% of patients with Parkinson's are diagnosed before age 60, stabilizing within people over 80 years of age. Men are also 1.5 times more likely to have Parkinson's than women.

Looking at the United States, there are at least 60,000 Americans being diagnosed per year; however, this does not reflect the thousands of undocumented or undetected cases. In terms of costs, it costs on average $2,500 a year for medication and $100,000 per patient for surgical treatments (DBS as mentioned previously).

Parkinson's has been identified to be more common amongst Caucasians than in people of color, namely Black or Asian. A report concluded that the incidence of Parkinson's occurred 13.6/100,000 Whites, 11.3/100,000 Asians and 10.2/100,000 in Blacks.

FIS SURVEY ANALYSIS

BY HUGO WONG (Y13)

Internet Addiction and Usage Habits Survey

Addiction refers to compulsive behaviour that leads to negative effects. In this survey, we will be talking about internet addiction, which is the compulsive behaviour to participate in any online-related activities.

With the constant improvement of technology, more and more teenagers are finding themselves constantly on the internet. While the internet can bring about many benefits for both entertainment and educational purposes, heavy internet usage in teenagers is associated with various physical and psychological problems. Examples of physical issues include constant headaches, dry eyes, back pain and sleeping problems while examples of psychological issues include depression, loss of relationships and procrastination among various others. These issues affect productivity to a great extent, thus internet addiction is hugely undesirable in students. The survey was sent to all students in secondary FIS and sought to find the reasons behind internet addiction and the extent to which teenagers are addicted to the internet.

Question 1

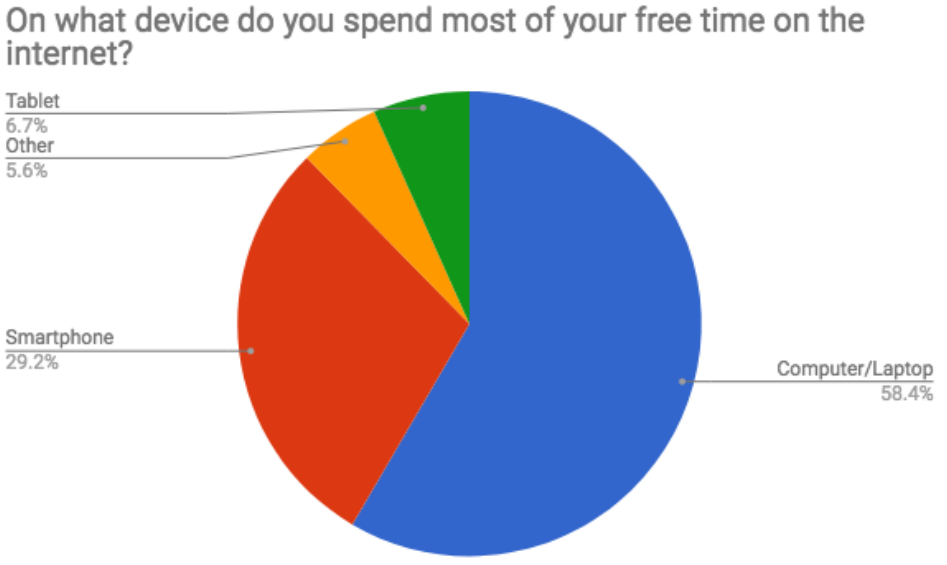


Fig. 1

Unsurprisingly, the vast majority of respondents to this question spend most of their free time on a computer, laptop, or smartphone (87.6% total). These devices in particular have become almost a necessity to most teenagers, fueled by their ever-growing use in daily life and work. Of all respondents, only one person did not have their own device. The widespread availability of technology and its portability only serves to promote more usage, and this leads to a lot more people at risk of succumbing to internet addiction.

Question 2

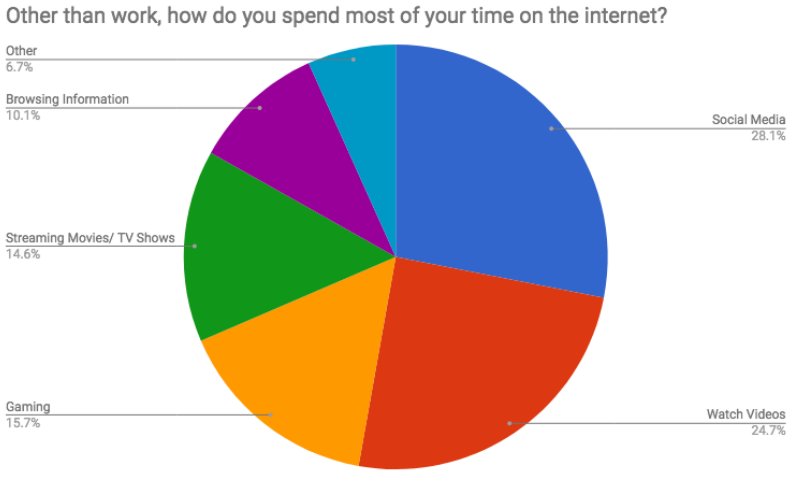


Fig. 2

The way teenagers spend their free time on the internet has a big impact on how much time they spend on the internet. Social media is the most popular activity (28.1%), followed by watching videos (24.7%), gaming (15.7%) and streaming movies/TV shows (14.6%). Interestingly, all of these 4 activities are more popular in this survey's respondents than in multiple similar surveys targeted at adults. It is no coincidence that teenagers are stereotypically more easily addicted to the internet than adults as all of these activities are addictive to some extent while adults generally use the internet more for informational purposes (ex. reading content, reading news, searching for information, etc.) than teenagers (less than 16.8% of respondents used the internet mainly for informational purposes).

Social media in particular is surprisingly addictive: researchers at Harvard University sought to understand why it is so easy to get addicted to social media and they found that self-disclosure communication greatly stimulates the brain, in the same way food and sex do. Watching videos, movies, TV series and gaming is addictive for another reason: if the fact that they are all forms of entertainment designed to attract the user isn't enough, they can all act as escape mechanisms: a way to avoid concerns in reality, which is especially attractive to teenagers who are prone to more stress. To reduce the risk of internet addiction, teenagers could limit their time spent on these more addictive activities and focus on using the internet more for informational purposes rather than entertainment.

Question 3

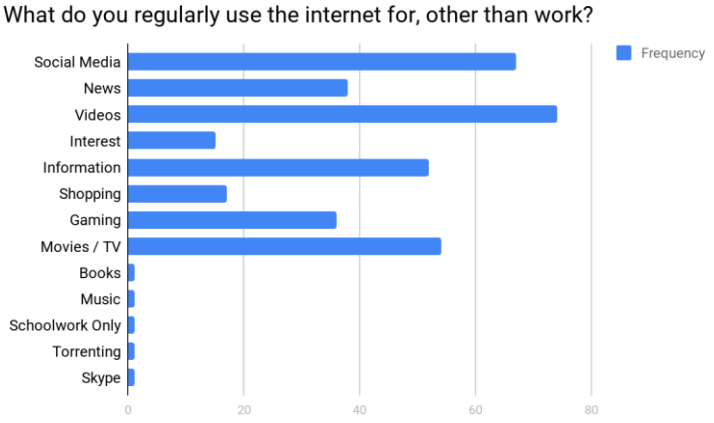


Fig. 3

An identical question was asked in the survey, but this time allowing multiple responses to be ticked. Three of the four activities mentioned above were very popular, with 80.4% of respondents using the internet to watch videos regularly, 72.8% using social media, and 58.7% streaming movies/TV shows. These all correlate with the amount of responses in the previous question: however, gaming was relatively less popular in this question than expected (at 39.1%). The fact that the amount of people listing gaming as the activity they spend the most time on was nearly identical to the amount who listed streaming movies/TV shows despite there being nearly twice as many people streaming movies/TV shows in comparison to gaming suggests that gaming is especially addictive.

This conclusion, despite there not being significant research done to show that gaming is more addictive than the other activities listed above, is to be expected. Gaming is stereotypically highly addictive and society frowns on gaming much more than these other activities, with both the American Psychiatric Association and the World Health Organisation listing it as a mental disorder. The effects of gaming addiction could also be more varied and apparent than other addictions, leading to greater awareness of the issue. A study done at the University of Bergen came to the conclusion that all of headaches, neck/back pain, palpitations, sleepiness during daytime, digestive problems, sleep problems and sadness occured at greater frequencies in those with a gaming addiction than those without.

Question 4

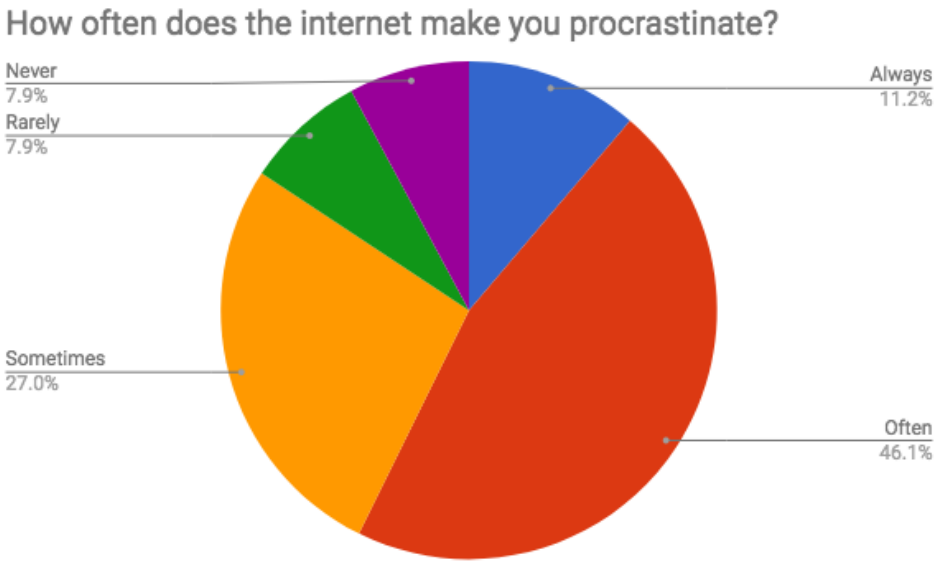


Fig. 4

This question was asked in order to acquire an estimation of the extent to which internet usage could affect education. More than half of the respondents answered that the internet made them procrastinate often or more (57.3%) and only 15.8% of respondents said that the internet rarely or never made them procrastinate. Procrastination is a side effect of internet addiction and the fact that more than half of the respondents regularly suffer from procrastination due to the internet speaks to how easy it is to become addicted. Procrastination leads to the inability to get important work done in a thorough and organised manner, meaning the existence of the internet can be a big hindrance in an educational environment despite its many uses.

Question 5

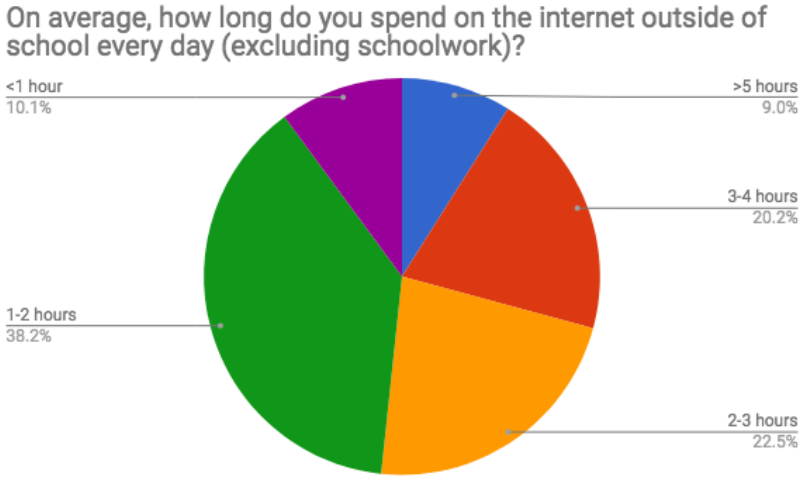


Fig. 5

The subject of how much time a teenager should spend on the internet every day is a very controversial question. Many research conclusions and suggestions are found to contradict each other and there is a lack of clear guidelines on how much time on the internet is suitable for a teenager. From the survey, the results are quite evenly spread, though the majority of respondents spend 1-2 hours of their free time on the internet each day (38.2%) or 2-4 hours (42.7%). Some research studies suggest that more than 2 hours is an unhealthy amount, while others suggest that the limit should be placed at around 4 hours. However, there is an overall consensus that more time on the internet does not lead to positive impacts, so I still suggest spending less time on the internet, preferably averaging 2 hours a day.

Question 6

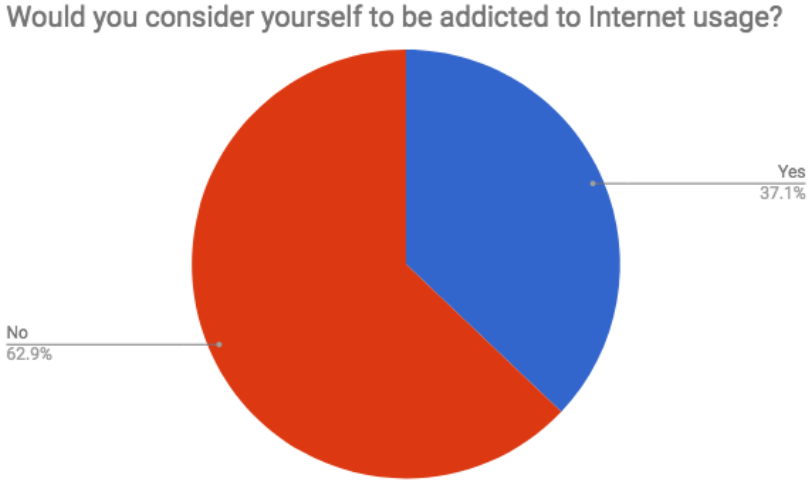


Fig. 6

This final question sought to estimate the proportion of teenagers addicted to internet usage. 37.1% of respondents considered themselves addicted and 62.9% did not. Even by pure numbers, 37.1% is very high, letting us conclude that more than a third of teenagers are addicted to the internet. However, there are problems with the reliability of these statistics as there might be people who overestimate the meaning of the word addiction.

The Different Teachings of Medicine

By Cloe Cheung (Y13)

When choosing which medical school, you would like to apply to, it is very important to look at the type of course and its structure that the university offers. Here is a quick rundown of the different medicine course types offered by universities. Please note that the example schools are based on information compiled from *The Medic Portal*, as different websites give different information about the course type for each medical school.

Traditional

A traditional course is divided into pre-clinical and clinical years. During pre-clinical years, you would spend most of your time in lectures and seminars. Lectures would cover much medical and scientific knowledge across disciplines, with many separate modules such as physiology, biochemistry and anatomy. Afterwards, the clinical years would be mainly in the form of hospital placements, with much fewer lectures or tutorials.

Examples of traditional schools: Oxford, Cambridge

Integrated

An integrated course is one of the most common course types in the UK. The teaching style is also mostly in the form of lectures and seminars. Diverging from the traditional approach, knowledge is grouped into a “system-based approach”, where a main body system is taught at a time, and the physiology, biochemistry, pharmacology and pathology of this body system is taught. The integrated course also allows for earlier exposure to the clinical world.

Examples of integrated schools: Imperial, Bristol, Birmingham, Edinburgh

Problem-Based Learning (PBL)

A PBL course is more focused on self-directed learning. The teaching style is in the form of group work, where students are given medical cases to discuss during sessions. A facilitator is there to observe and help students get the most out of the session but are not there to give out factual information. However, there are few medical schools that solely use PBL as their way of teaching, but rather the PBL course is supplemented with lectures and seminars.

Example of PBL schools: Manchester, Queen Mary

Case-Based Learning (CBL)

CBL course is often confused with a PBL course as they are very similar, but there are some differences. The teaching style is in the form of “trigger cases”, led by tutors with experience in the particular field you would be discussing. You would work in small groups, discussing and sharing ideas about the skill and knowledge needed for the particular case. CBL is supplemented with lectures and seminars as well.

Example of CBL schools: Liverpool, Cardiff, Glasgow

Extra: Intercalation

Intercalation is when you spend an extra year during your 5-year medical degree to study another degree of your choice. Then, you would graduate from medical school with two degrees. For most medical schools this is optional, but it is compulsory in others.

Examples of compulsory intercalation: Imperial, UCL, Nottingham
Examples of optional intercalation: Newcastle, Leeds, Hull York

Of course, this is just a brief overview of the main course types you would expect to find at medical school, and it is important that you spend some time thinking about which course type you think would suit you best.