

ISSUE NO: 10



# The Brain's Noise Filter

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The frothing and foaming waters of Niagara Falls, one of the greatest waterfalls in the world, are constantly roaring at an astounding 87-95 decibels. That is as loud as a propeller plane flying over your head. Or a lion roaring right at you while you wonder how to escape from the giant cat.

Either way, that's some very loud noise. So how do people living in the surrounding areas go to sleep at night? Same holds for those living next to airports or train stations.

Well that's where our brain's filtering system comes into play. Our brain does something called Sensory Gating which basically filters out any unwanted information. In this way, only the important things get sent over to higher processing centers while unnecessary sensations are filtered out. What's more fascinating is that this process goes on constantly without us even realizing. It holds true for everyone, even those living in quiet places and simply going about their daily lives.

So why is it important to filter out sensations all the time? Shouldn't it be better if we get more information about our surroundings?As a matter of fact, they can be dangerous.

At any given point, all our major senses get so much information that processing all of it can cause someone to lose their mind. Filtering is what protects us from this chaos by maintaining attention on those stimuli which are important.

Researchers have found that one of the primary brain regions involved in this phenomenon is the thalamus. Being a relay center that sits at the junction between our cerebrum and the rest of the nervous system, it decides what all information requires immediate attention while the rest is either discarded or put on the back burner. However that's simply a small part of the larger picture. Networks of neurons are involved in this phenomenon, some of which are in the hippocampus and the brainstem while others are in the prefrontal cortex of the brain. These regions help shift attention from one object to another, such as focusing on a friend's conversation while ignoring the loud background music at a party.

Our brain is like a well-oiled machine, each cog and wheel serving a great purpose. Even if a tiny piece stopped moving, the entire thing can fall to shambles. A dysfunction in this system can cause mental disorders such as Schizophrenia. The person begins to hallucinate, that is see or hear things that aren't there, or become delusional and withdraw from their friends and family - a frightening scenario faced by thousands in the world.



Image credit: Light G. A., Braff D. L. Sensory gating deficits in schizophrenia: can we parse the effects of medication, nicotine use, and changes in clinical status? Clinical Neuroscience Research, 2003;3(1-2), 47–54. doi:10.1016/s1566-2772(03)00018-5

#### Suggested Reading:

•https://www.psychologytoday.com/intl/blog/ brain-babble/201502/is-how-the-brain-filters-out-unimportant-details?amp

 https://www.huffpost.com/entry/does-the-brain-filter-out b 9859158

•https://nuscimag.com/through-the-looking-glassmy-sensory-gating-disorder-77ea0bc65d7

# In The News

#### **Imaging Black Holes**

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black hole is an object that has a very high mass Apacked into a very small space - as small as you can possibly imagine i.e., infinitely small. This gives it an infinite density and hence an extremely large gravitational field, i.e., the black hole is able to exert a large force on any mass that comes near it, pulling it into itself. Photons are the fastest entities in the universe, but they also get trapped in this field. Thus, this object does not emit light and hence its name. The black hole is so massive that near its centre, the escape velocity (the velocity required to escape the gravitational pull) is greater than the speed of light. However, as one moves further away from the centre, the escape velocity decreases. The distance at which the escape velocity is equal to the speed of light is called the Event Horizon of the black hole. Thus, the event horizon can be thought to be a boundary that separates, the 'seen' and the 'unseen'.

How do we 'see' any object ? We see it because of ambient photons that scatter off of the surface of the object are detected by our eye; we do not see in the dark because there is no source of ambient photons. For a black hole, the ambient photons are provided the highly energetic radiation generated by physical processes in the accretion disk - a disk of very hot gas that is orbits around the black hole, further away from the event horizon. As the photon approaches the black hole, the strong gravity of the black hole bends the path of the photon, much like a lens that bends optical light. This process is known as gravitational lensing. The expected signature of the black hole with a thick accretion disk corresponds to a dark patch surrounded by a bright ring.

On 10th April 2019. the team of scientists working on the Event Horizon Telescope (EHT) project announced that they had indeed observed such a pattern around the suspected black hole at the centre of M87, a massive galaxy in the nearby Virgo galaxy cluster. Relativistic effects due to the high speed rotation of the gas in the accretion disk give rise to the crescent shaped arcs observed in the images (see figure 1). By measuring the diameter of the ring and knowing the distance to M87 they computed the mass of the black hole to be 6.5 billion times that of the Sun with an accuracy of about ten percent. Comparing the images to intensive computational calculations gives a lot of information about the physical processes in the accompanying accretion disk.

This is indeed a remarkable achievement - the distance from earth to M87 is a hundred million times



Image of the black hole taken by the EHT.

(:https://www.eso.org/public/images/eso1907a/)

larger than the diameter of the ring that one would like to detect. This is similar to observing an individual strand of hair from an aeroplane in the sky which is flying at a height of about ten kilometres. The EHT is not one telescope: this feat was achieved using a global network of radio telescopes spread throughout the world, so as to form one virtual Earth-sized telescope. This idea is more technically called Very Long Baseline Interferometry or VLBI. Incidentally, another way of detecting a black hole is to examine the motion of the stars around a suspected candidate. In 2008, the research group of Andrea Ghez, confirmed the presence of a supermassive black hole at the centre of our own Milky Way in the bright region known as Sagittarius A\*. Both these discoveries agree with the hypothesis that the centre of every galaxy hosts a supermassive black hole. Its surrounding central region is called the Active Galactic Nucleus (AGN), in analogy with the nucleus of a cell, which is more than a billion billion times smaller.

# **Through The Lens**

Josette Misquita, TYBSc Life Sciences, St. Xavier's College - Autonomous, Mumbai.



Can you identify this insect that is known for it's loud chirping sound?

# **Science In Daily Life**

# New(ro)Marketing

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ecently, Instagram came up with this tab called K'Your Activity' which tells the users their average daily usage of the application. It was only then that people realised how they were wasting around 2 to 3 hours on only one social media app daily. Are you one of those who wonder how you open up one of these social media apps for just a minute but end up spending hours in one go? Well if you are, then we have an answer here! These social media companies such as Facebook and Instagram have based their user interface on an experiment called Bottomless Bowls (2005 Jan; Wansink B and Painter JE), where 54 subjects were served soup in self-refilling bowls without their knowledge, and the result- they ended up consuming 173% of the normal quantity of the bowl !! Using this conclusion, these apps give the user an endless scrolling facility, thereby keeping the consumers engaged.

This was one example where companies are playing with people's brains to earn profits and believe it or not, this isn't the only one. Businesses have started using these neuroscience techniques to predict consumers' behaviour, thereby giving birth to Neuromarketing. Simply stated, Neuromarketing unfolds how a consumer's subconscious brain reacts to the stimuli to take a decision. To study this, one needs to understand how different parts of the brain works. For the purpose of Neuromarketing, there are figuratively three parts of the brain: 1. The New brain which gives logic and rationale; 2. The Middle brain which feels and emotionalises; and 3. The Old brain which takes decisions on the basis of the inputs from the two other parts. This means that it is the old brain which marketeers need to tap and control.

According to Patrick Renvoise, an expert on the subject, there are Six Stimuli which impact consumers' behaviour starting with the 'ME' Factor, which tells the marketers to talk less about their company and more about the consumer. This is the reason you'll see companies selling the benefits of you being fair rather than the features of the fairness cream. Next comes, Contrast. The old brain catches the vivid difference between comparable items very quickly. Contrast allows the old brain to make quick, risk-free decisions. Now you know why Sanjeev Kapoor was washing clothes with both Ariel and 'Normal Detergent' on your TV screens. The third one is 'The Tangible Input' which simply means that the old brain recognises only what is simple, familiar, and tangible, or else it gets transferred to the new brain, thereby delaying the decision making process. Hopefully, our textbook authors will understand this one day! Ever heard "The first impression is the last impression"? Well, the next stimulus is what talks about the old brain recalling only the opening and finale of an event and overlooking the in-betweens. This is why some Youtube ads deliver their main messages before the user gets the 'Skip Ad' option. The fifth stimulus is called 'Visual' and as the word states, it refers to using more visual elements than words in putting marketing efforts. Hence, it is rightly said, "Jo dikhta hai, wohi bikta hai". Think of the last print advertisement you loved, wasn't it a 'visual'? Lastly, we have the stimulus of which neurobiologists have been trying to explain the scientific angle to the world. Well, it's called Emotion -- an electrochemical transmission for the neuroscientists, but a competitive opportunity for the marketeers. You related to that advertisement strongly, well that was just a marketing technique you got triggered with.

Neuromarketing is not just a post-purchase observation. It includes a whole set of experiments which are conducted before even releasing an advertisement in the market. Processes like fMRI, Electroencephalography (EEG),Positron Emission Tomography, facial coding, and eye-tracking are used to learn how consumers respond and feel to different stimuli.

In conclusion, this 'new' marketing has been trying to tap on the source of 95% of our brain activity the subconscious mind, and if our response pattern is set to be studied, it is succeeding with flying colours. Did you just think of a rainbow? That's how Neuromarketing works!

Sources:https://conversionxl.com/blog/old-brain-stimuli/

**Stimulate Your Grey** 

- Antara Raghvi, Class IX, Navy Children School Mumbai.



Baobab trees are mainly found in arid areas of Madagascar and mainland Africa (though there are 120 of them in Mumbai!). They are thought to be thousands of years old, and are often called the oldest flowering plants. But this is rather difficult to verify due to a structural difference when compared to other species of tree. What is this difference ?

# Long, Long Ago Monkey see, Monkey do

Deepika Jauhar, MSc Life Sciences, Sophia College – Autonomous, Mumbai.

Long ago, in evolutionary time, a special feature that makes us human evolved. Some special neurons came up that gave us the ability to empathize. What do we mean by empathy and how does it make us who we are ?

You are playing dodgeball with friends and you see a friend getting smacked in the face with the ball, does your own face recoil as if you have been hit? When you see someone smile at you, without thinking you smile back. Ever noticed how your face grimaces when you see someone else eat a lemon? Why does this happen? Why do you end up copying others' actions? This unconscious mimicking of other people's facial expressions and body movements is something brought about by a special neuronal network in your brain. The neurons involved in this network are aptly called as mirror neurons. As the name suggests, they help coordinate the necessary movements for such actions. Some facts about mirror neurons:

•First discovered in Macaque monkeys. They are found only in primates.

•They are responsible for making you yawn after you see someone else yawn.

•This is not their only job, they coordinate these same movements when you are consciously making them (not mimicking others!).

The question arises, why do we need such mimicking behaviour? It helps us learn, helps us empathize with others. Humans, being social animals, need this form of behaviour in order to understand one another and interact with each other. Infants, children, learn how to perform basic actions by imitating their parents and others around them. Mirror neurons play a crucial role in childhood development and forming relations with others around us. It is easier and faster for us to learn by observing someone, rather than by explanation. Think about it, would you be able to learn how to swim by just being told how to, or by observing how to swim as well.Now knowing that it is important and crucial for our social behaviour and learning, what would happen if something goes wrong in this circuitry? Autism Spectrum Disorders (ASD) and Psychopathy have been linked with irregularities in the mirror neuronal network. (However it doesn't mean that the mirror neurons are solely responsible for these conditions, it simply is one of the many things that lead to either of the conditions.) Psychopathic people are unable to empathise with people, despite understanding emotions. They are able to react back to people, but actually fail to truly understand other people's feelings. In ASD, the children cannot understand others expressions, they are unable to empathize and react back. This results in poor relationship skills which is a characteristic trait of ASD.

# **Thought Byte**

"We would be worse than we are without the good books we have read, more conformist, not as restless, more submissive, and the critical spirit, the engine of progress, would not even exist. Like writing, reading is a protest against the insufficiencies of life. When we look in fiction for what is missing in life, we are saying, with no need to say it or even to know it, that life as it is does not satisfy our thirst for the absolute – the foundation of the human condition – and should be better. We invent fictions in order to live somehow the many lives we would like to lead when we barely have one at our disposal." *-Mario Vargas Llosa, Nobel Prize in Literature 2010.* 

**Answer: Through the Lens** - *Teleogryllus Emma*(cricket). The loud chirping sound made by Male crickets is known as stridulation. (They rub the upper and lower parts of their wings together). It is a call to attract the females. The females have an ovipositer that helps them lay eggs in organic matter.

Answer: Stimulate Your Grey- They lack growth rings.

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