PULSE

North London Collegiate School Science Magazine

Edition 1
OCTOBER 2021

Front cover made by graphic designer Janaine Ho

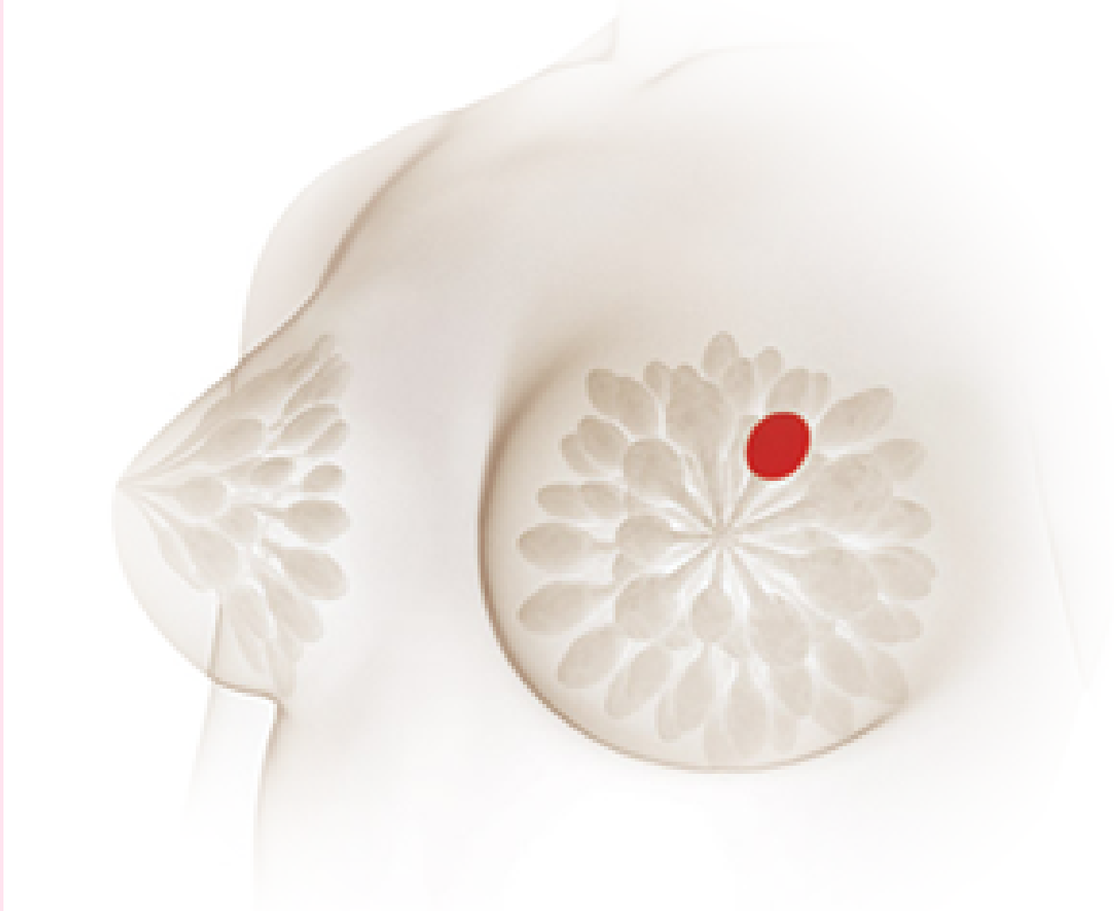
BREAST CANCER AWARENESS MONTH

October is breast cancer awareness month, which is an annual campaign to increase awareness of the disease.

What is breast cancer?

Breast cancer is the most common cancer occurring among women in Singapore, with over 2000 women being diagnosed every year. (Cancer and Cancer, 2021)

The female breast is made up of milk ducts and glands, and it is within these ducts and glands that breast cancer commonly develops. The cancer starts off with the abnormal growth of breast cells, which due to rapid division results in the formation of a lump or a mass. These malignant cells may then invade the surrounding tissue (known as stroma) and metasize to the lymph nodes or other parts of the body.



There are 2 different treatment paths one can undertake

1) Locoregional treatment - pairs surgery with radiotherapy to treat cancer cells in the breast and armpit lymph nodes

Some surgical techniques used to treat breast cancer include:

- Lumpectomy - removal of the tumour along with a small margin of surrounding healthy tissue
- Mastectomy - removal of the whole breast including the nipple
- Axilllary lymph node dissection - if cancer is found in the sentinel lymph nodes, additional lymph nodes in the armpit may require removal
- Contralateral prophylactic mastectomy - risk-reducing procedure of removing both breasts

Radiotherapy uses high energy rays to target and kill cancer cells, to lower the chances of the cancer returning. It is vital after a breast-conserving surgery like lumpectomy, since much of the breast tissue is left intact.

2) Systemic treatment - utilising chemotherapy or hormonal drugs to either shrink a large tumour to make it easier for removal, or to try and control the cancer spreading and make symptoms more manageable.

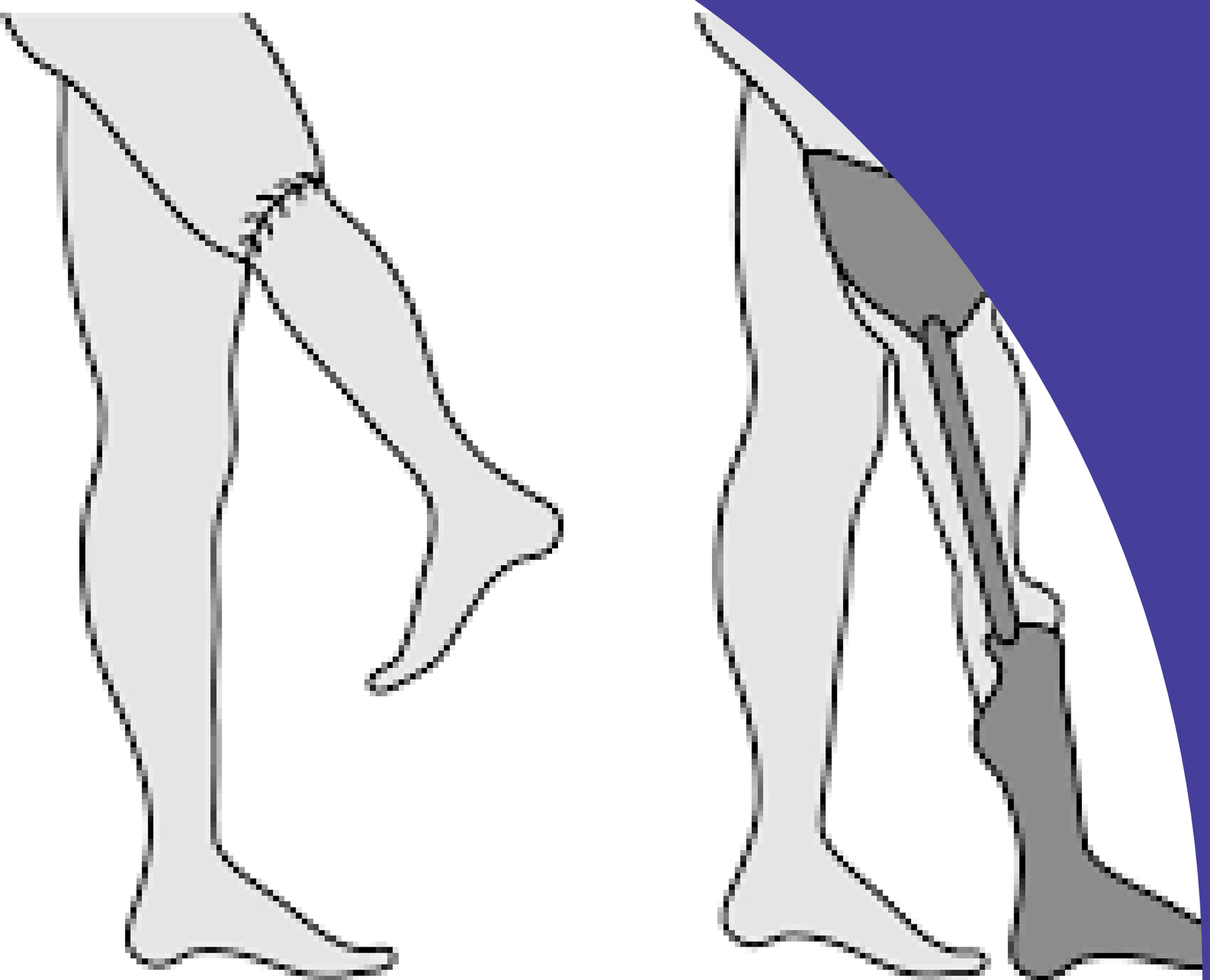
Not only do breast cancer patients have to deal with the difficulties of treatment, they also have to find ways to handle the multitude of emotions that come hand-in-hand with such a diagnosis - the issues regarding physical change, the feelings of uncertainty, among others. Our hearts go out to all these strong individuals and their affected loved ones.

By Jieun Yum (G11)

ROTATIONPLASTY

By Janaine Ho (G11)

Rotationplasty is a surgery performed on individuals with bone cancer (commonly osteosarcoma or Ewing sarcoma) in the knee region as an alternative to a lower leg amputation. The surgery procedure involves the surgeon severing the leg above the knee, and reattaching the ankle at the thigh but with a 180° rotation. This is to remove the tumour in the knee, and will have the ankle joint acting as the new knee joint. (Rotationplasty | Boston Children's Hospital, 2021)



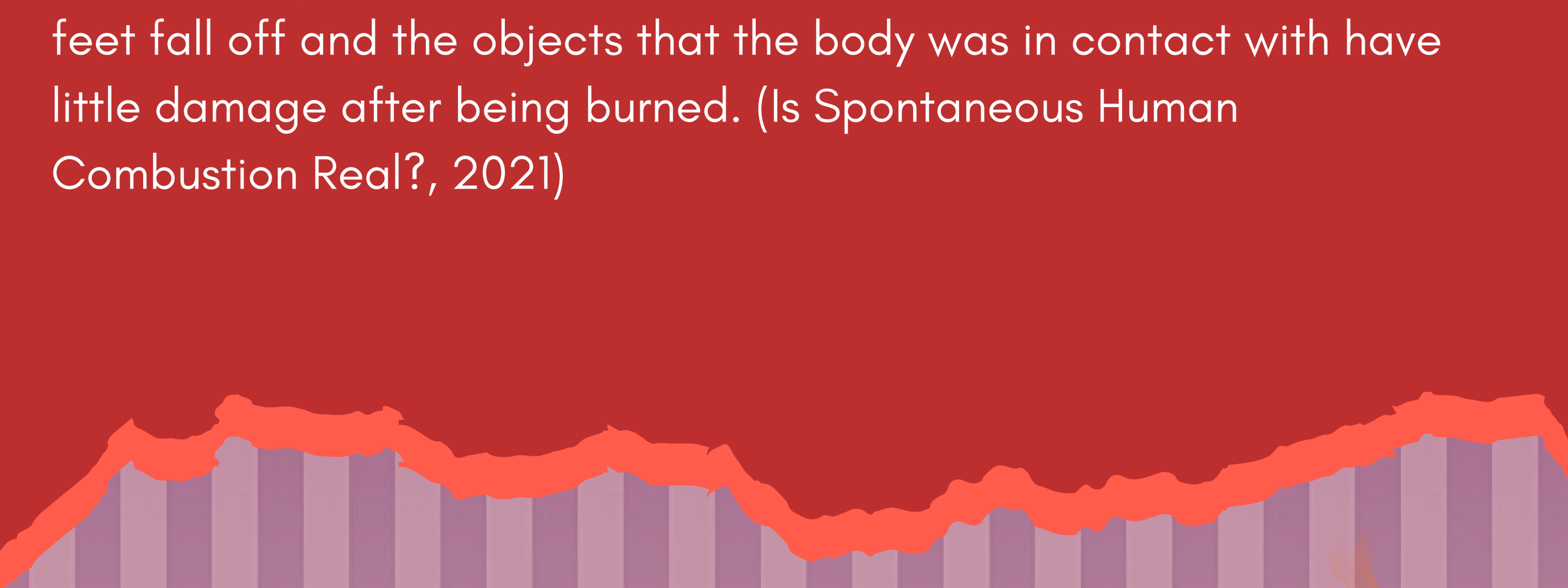
Risks & Benefits

The surgery includes many benefits such as reducing the risk of a phantom limb pain, allowing patient to wear a prosthetic limb while maintaining the mobility of having a joint and better balance. However, some risks during the procedure consists of deep vein thrombosis (a large blood clot in the vein) and leg bone fractures. (Rotationplasty | Boston Children's Hospital, 2021).

SPONTANEOUS HUMAN COMBUSTION

By Janaine Ho (G11)

An italian noblewoman, Cornelia Zangheri Bandi, died in 1731 in mysterious circumstances with only her ashes remaining in her bed, leading to the idea of spontaneous human combustion proposed by Paul Rolli in 1746. The mystery baffled the world as the fire that could have burned Bandi seemed to have been started in the body and was confined within. Spontaneous human combustion is the death of an individual from a fire that originates without an apparent external source of ignition. The events of spontaneous human combustion all have common characteristics which include victims being chronic alcoholics, mostly elderly females, hands and feet fall off and the objects that the body was in contact with have little damage after being burned. (Is Spontaneous Human Combustion Real?, 2021)



Truth or Myth?

The human body is 60% water, which means that the most flammable properties in our body are fat tissues and methane gas, which makes it unlikely that spontaneous human combustion can occur as a source would need to be present. Many scientists believe that the original source could be an undetected cigarette or match that victims may have accidentally dropped onto themselves. This is supported by the fact that many of the victims were found close to a source of fire. (Spontaneous Human Combustion: Facts & Theories, 2021)

On the other hand, in order for the body to be reduced to ashes, it would have to reach a temperature of approximately 982°C. This would be difficult to occur without the surrounding furniture being damaged as well, and in most suspected cases of spontaneous human combustion, the furniture around was barely damaged.

A hypothesis proposed by British biologist Brian J. Ford states that a certain diet in which acetone is built up in the body could potentially lead to spontaneous combustion. Acetone is a colourless and highly flammable liquid with a pungent odor. It can build up in the body through extreme alcoholism and obesity. (Is spontaneous human combustion real?, 2021)

In conclusion, there is currently no hard evidence that proves definitively as to whether spontaneous human combustion is real or merely just a myth.

mRNA vaccines

What are they and how do they work?

By Mary Richter (G11)

To understand how mRNA vaccines work, let's first understand what mRNA is. mRNA stands for messenger ribonucleic acid; its role is as a messenger in a process called protein synthesis, carrying genetic code from a cell's nucleus to its ribosomes. An mRNA vaccine works by using a piece of a virus' corresponding mRNA, usually taken from its membrane. When injected into the body, our immune systems will generate specific antibodies for this virus. These antibodies are stored in memory cells so that if you do get infected with the virus, your body can quickly react and begin producing antibodies to fight off the virus. Unlike other vaccines, this is not an active or inactive vaccine, meaning you cannot become infected with the virus. I hope this gives you a better understanding of mRNA vaccines.

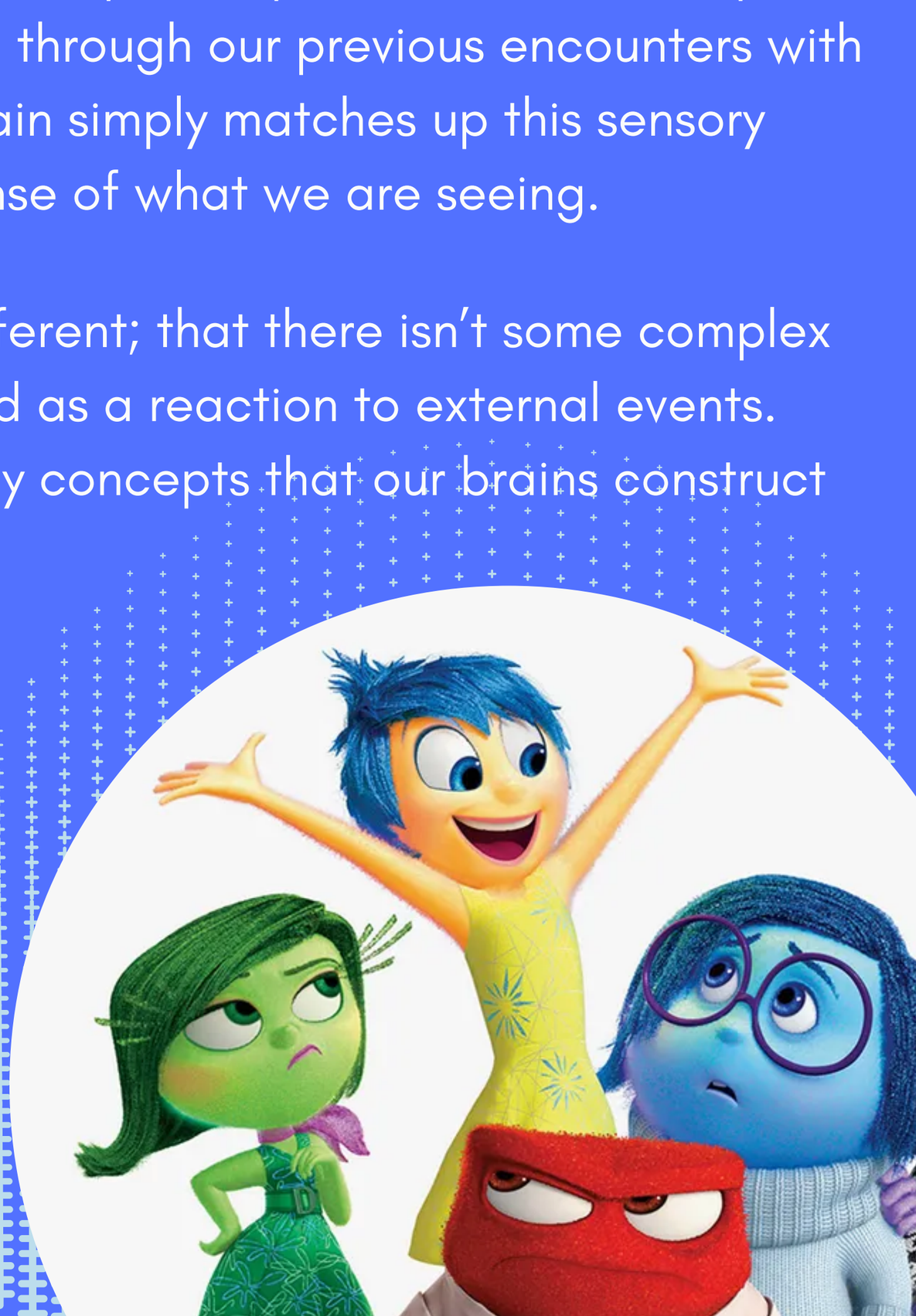
The Theory of Constructed Emotion

By Jieun Yum (G11)

To capture the essence of human nature, ancient philosophers and physicians divided the human mind into mental faculties encompassing categories for thinking, feeling and volition. From this sprouted the classical view of emotions, which assumes that the emotion categories we experience and perceive as distinct (such as anger, sadness, fear, and disgust) must also be distinct in nature. However, psychology professor and neuroscientist Dr Lisa Feldman Barrett quite effectively contradicted this wide-held belief by proposing a theory that provided a different approach to the understanding of emotions - the theory of constructed emotion. This theory brings into question the assumption that emotions are biologically hardwired, and instead argues its subjectivity.

In order to make sense of the world around us, our brain categorises information based on our past experiences, into concepts. Concepts are compressed representations of thousands and thousands of past experiences. For example, the 'chair' is a concept we have formulated through our previous encounters with chairs. So everytime we see a chair, the brain simply matches up this sensory input to the concept of a chair to make sense of what we are seeing.

This theory argues that emotions are no different; that there isn't some complex circuit that resides within our skull, triggered as a reaction to external events. Instead, it suggests that emotions are simply concepts that our brains construct to make sense of the world.



To better understand this, we have to first look at the idea of interoception. Interoception is the core of the brain's internal model, which serves to model the world from the perspective of our physiological needs. By predicting and categorising the purely physical sensations that come from within our body - lower dimensional feelings of pleasure, displeasure, arousal, and calmness, this process allows us to infer about the causes of these sensations and drive action to deal with them. (Barrett, 2016)

This idea can be applied to the phrase 'butterflies in my stomach'. Your interoceptive sense is what helps you perceive these inner sensations, to provide an appropriate explanation by making connections with its circumstance. For example, if I experience this sensation before a concert, my brain tells me I am excited. But this same feeling of discomfort can be given a completely different label if instead of a concert, I am standing in front of a crowd right before a speech.

Br Barrett applies this idea of predictive coding to the subjective world of emotions, suggesting that the emotions we feel are not pure reactions to an external stimulus, simply predictions of the appropriate way for our body to react. Just like how our mind interprets something with a back and four legs as a chair, it might interpret a pattern of bodily sensations as 'fear', 'sadness' or 'joy'.

But if emotions are purely predicted concepts, how is it that we can feel them so intensely? Dr Barrett links this question back to the idea of concepts. Concepts are not simply labels that our brain constructs through passive observation, for they are what helps us perceive things in the first place. Our world is always providing us with incomplete, ambiguous information, and it is through the utilisation of concepts that our brain can piece together this information.

This is not to say emotions are not real, just that what these emotions may be telling us might not be. The theory of constructed emotion argues that we are in fact not at the mercy of emotion circuits ingrained within our system. You have more control over your emotions than you think.

(How Emotions Are Made: The Theory of Constructed Emotion - Forte Labs, 2021)

Psychology of Stockholm syndrome

By Janaine Ho (G11)

Stockholm syndrome is a term coined after a bank robbery in Stockholm, Sweden in the August of 1973. The bank robbers took 4 of the employees hostage for 6 days within the bank's vault. During the period of negotiation, the captors and the captives developed a bond, with the hostages having a positive feeling towards the robbers. In a call to the Prime Minister Olof Palme, one of the hostages claimed that she completely trusted her captors and only feared she would be harmed during the police confrontation. (Stockholm syndrome | Definition, Examples, & Facts, 2021)

Psychologists over the years have proposed that when captors threaten the victim's life and decide to keep them alive, the relief from the victim is transposed into a feeling of gratitude towards the captor for allowing them to keep their lives.

This proves that the victims desire to live is greater than the hatred for the captors. Victims usually develop feelings of love, empathy, compassion and the desire to protect them. (What Is Stockholm Syndrome?, 2021)

In our modern society, most patients who suffer from Stockholm syndrome are usually victims of child abuse and physical or emotional domestic abuse. Some symptoms according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) include Post Traumatic Stress Disorder, depression, anxiety, insomnia and guilt.

LOCKED-IN SYNDROME

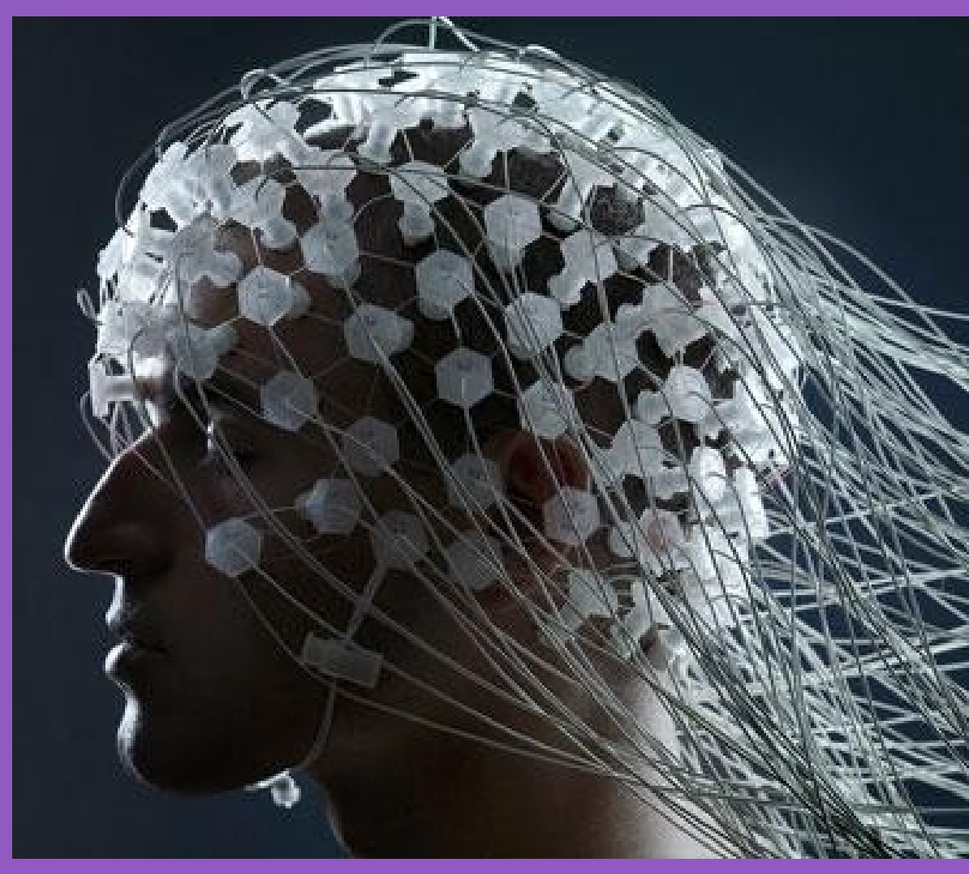
By Jieun Yum (G11)

Locked in syndrome is a devastating clinical condition where patients experience complete paralysis of all voluntary muscles except those that control movement of the eyes. Thus, despite being conscious with no loss of cognitive function, they are unable to move, show facial expression or speak. Their only form of communication is through vertical eye movements and blinking.

There are several possible causes of locked-in syndrome, with the most common one being strokes. Other causes include tumours, traumatic brain injuries, certain diseases, damage to nerve cells, iinfection, or even opioid use.

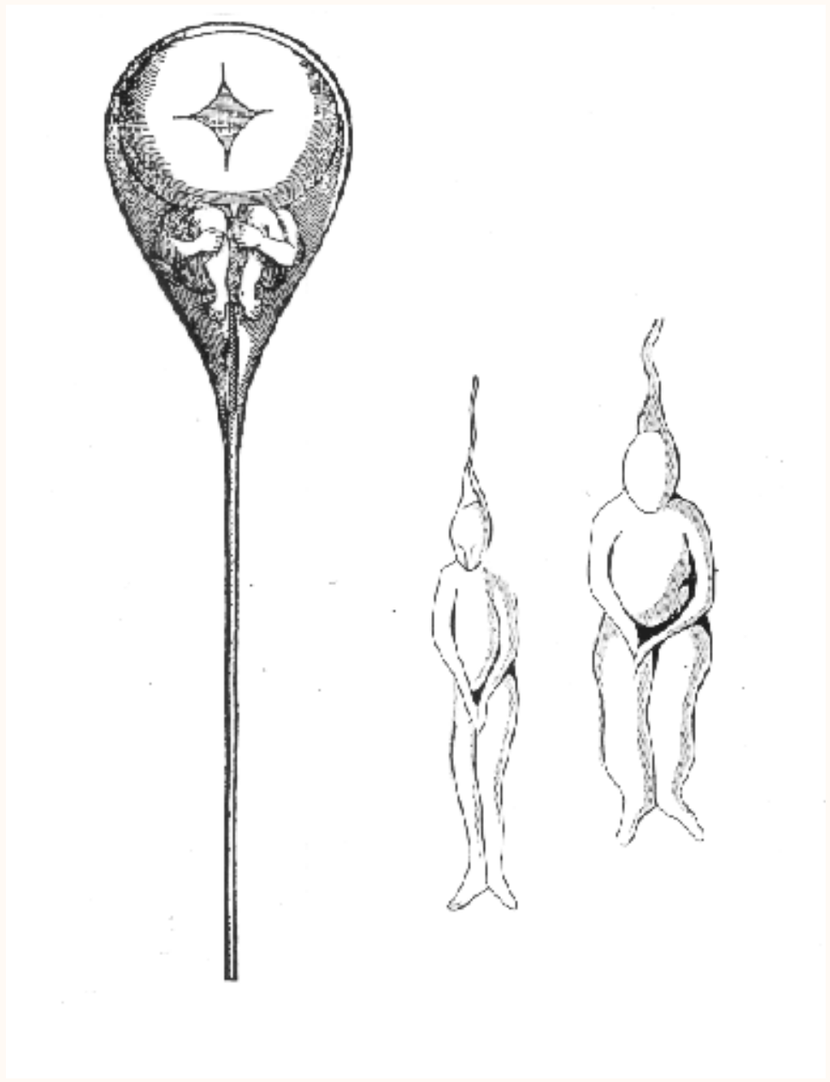
Currently, there is no specific treatment for locked-in syndrome. Supportive therapy, physical therapy, comfort care, nutritional support, and prevention of systemic complications serve as the mainstay of treatment for these patients. However, the development of technology is allowing for the production of improved methods to allow patients more freedom in both movement and communication.
(Locked-in syndrome | Genetic and Rare Diseases Information Center (GARD) - an NCATS Program, 2021)

Brain computer interfaces (BCI) acquires, analyses and translates brain signals into commands that are relayed to output devices to carry out desired actions. (Shih, Krusienski and Wolpaw, 2012)
They have potential to revolutionise the treatment of conditions like locked-in syndrome, by serving as a tool to help paralysed individuals control assistive devices using their thoughts.



DID YOU KNOW

Anthony Van Leewenhoek, the first scientist to discover sperm cells, believed they looked like this:



References

Cleveland Clinic. 2021. *Rotationplasty: What It Is, How It's Done, Outlook*. [online] Available at: <https://my.clevelandclinic.org/health/treatments/21536-rotationplasty#:~:text=Rotationplasty%20is%20a%20surgery%20for,a%20prosthesis%2C%20or%20artificial%20limb.> [Accessed 12 October 2021

Childrenshospital.org. 2021. Rotationplasty | Boston Children's Hospital. [online] Available at: <https://www.childrenshospital.org/conditions-and-treatments/treatments/rotationplasty> [Accessed 12 October 2021].

Encyclopedia Britannica. 2021. Is Spontaneous Human Combustion Real?. [online] Available at: <https://www.britannica.com/story/is-spontaneous-human-combustion-real> [Accessed 12 October 2021].

HISTORY. 2021. Is spontaneous human combustion real?. [online] Available at: <https://www.history.com/news/is-spontaneous-human-combustion-real> [Accessed 12 October 2021].

livescience.com. 2021. Spontaneous Human Combustion: Facts & Theories. [online] Available at: <https://www.livescience.com/42080-spontaneous-human-combustion.html> [Accessed 12 October 2021].

Barrett, L., 2016. The theory of constructed emotion: an active inference account of interoception and categorization. Social Cognitive and Affective Neuroscience, p.nsw154.

Forte Labs. 2021. How Emotions Are Made: The Theory of Constructed Emotion - Forte Labs. [online] Available at: <https://fortelabs.co/blog/how-emotions-are-made/> [Accessed 13 October 2021].

Cancer, B. and Cancer, B., 2021. Breast Cancer. [online] Singaporecancersociety.org.sg. Available at: <https://www.singaporecancersociety.org.sg/learn-about-cancer/types-of-cancer/breast-cancer.html#support-groups> [Accessed 13 October 2021].

Mayo Clinic. 2021. Breast cancer - Symptoms and causes. [online] Available at: <https://www.mayoclinic.org/diseases-conditions/breast-cancer/symptoms-causes/syc-20352470> [Accessed 13 October 2021].

Mayoclinic.org. 2021. Breast cancer - Diagnosis and treatment - Mayo Clinic. [online] Available at: <https://www.mayoclinic.org/diseases-conditions/breast-cancer/diagnosis-treatment/drc-20352475> [Accessed 13 October 2021].

Encyclopedia Britannica. 2021. *Stockholm syndrome | Definition, Examples, & Facts*. [online] Available at: <https://www.britannica.com/science/Stockholm-syndrome> [Accessed 13 October 2021].

WebMD. 2021. *What Is Stockholm Syndrome?*. [online] Available at: <https://www.webmd.com/mental-health/what-is-stockholm-syndrome> [Accessed 13 October 2021].

MSD Manual Professional Edition. 2021. Locked-In Syndrome - Neurologic Disorders - MSD Manual Professional Edition. [online] Available at: <https://www.msdmanuals.com/en-sg/professional/neurologic-disorders/coma-and-impaired-consciousness/locked-in-syndrome> [Accessed 13 October 2021].

Rarediseases.info.nih.gov. 2021. Locked-in syndrome | Genetic and Rare Diseases Information Center (GARD) – an NCATS Program. [online] Available at: <https://rarediseases.info.nih.gov/diseases/6919/locked-in-syndrome> [Accessed 13 October 2021].

Shih, J., Krusienski, D. and Wolpaw, J., 2012. Brain-Computer Interfaces in Medicine. Mayo Clinic Proceedings, 87(3), pp.268-279.

www.modernatx.com. (n.d.). mRNA Science and Function: What Does mRNA Do? - Moderna. [online] Available at: https://www.modernatx.com/mrna-technology/science-and-fundamentals-mrna-technology#:~:text=Messenger%20ribonucleuc%20acid%2C%20or%20mRNA. [Accessed: 15 October, 2021] medlineplus.gov. (n.d.). What are mRNA vaccines and how do they work?: MedlinePlus Genetics. [online] Available at: https://medlineplus.gov/genetics/understanding/therapy/mrnavaccines/. [Accessed: 15 October, 2021]

IMAGES

2021. [online] Available at: <https://medspace.mc.duke.edu/downloads/sj139236r?locale=zh> [Accessed 12 October 2021].

Encyclopedia Britannica. 2021. Is Spontaneous Human Combustion Real?. [online] Available at: <https://www.britannica.com/story/is-spontaneous-human-combustion-real> [Accessed 12 October 2021].