

EEGSynth=Brainbow

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Abstract— Upon learning about what Cognitive Decline can look like as a physical form in our brains as we grow older, I could see a link in how our brains are wired that could help us find a way to normalize ourselves later on in our lives. Through all the experiences I have had in my life in becoming a traveling musician, a freelance model, and a paid actress, the people whom have taught me the things that I will share in this report, deserve all the recognition for the knowledge they have placed upon me and the other's whose lives they have influenced. They taught me how to live on a strict diet based off of the effects of certain foods on your digestive system as well as how to keep cognitive ability through my mid 50's by keeping an active lifestyle. This document will also explain my research in healing consciousness with Neuroplasticity. It's amazing how much our life changes when we begin to change our thoughts.

Index Terms—EEG, Neuroplasticity .

I. INTRODUCTION

Highlight My Research began back in 2014 when I was at the home of my Middle-School friend's house, Andrew Miller. He had fixed the wiring in an amp head for me and I sat down while he put on a couple of YouTube videos about physics where a person was able to create patterns by applying a certain amount of frequency to a plate of salt sitting on top of a tone generator.

“So, this experiment is the Chladni plate experiment. I used a tone generator, a wave driver (speaker) and a metal plate attached to the speaker. First, add sand to the plate then begin playing a tone. Certain frequencies vibrate the metal plate in such a way that it creates areas where there is no vibration. The sand “falls” into those areas, creating beautiful geometric patterns. As the frequency increases in pitch, the patterns become more complex.”—**Brusspup**

(All of the equipment for this experiment was provided by PASCO scientific)

“Ernst Chladni was a Physicist and Musician who was born in Hungary and deceased in Germany. He is known by many as, “The Father of Acoustics.” One of Chladni's best-known achievements was inventing a technique to show the various modes of vibration on a rigid surface. When resonating, a plate or membrane is divided into regions that vibrate in opposite directions, bounded by lines where no vibration occurs (nodal lines). Chladni repeated the pioneering experiments of Robert Hooke who, on July 8, 1680, had observed the nodal patterns associated with the vibrations of glass plates. Hooke ran a violin bow along the edge of a plate covered with flour and saw the nodal patterns emerge.[In quantum mechanics, Chladni figures (“nodal patterns”) are

known to be related to the solutions of the Schrödinger equation for one-electron atoms, and the mathematics describing them was used by Erwin Schrödinger to arrive at the understanding of electron orbitals.”—**Wikipedia**

What if we were able to use this data to translate how our synapses create patterns of signal in different parts of our brain when we are active vs when we are asleep? A Synapse is a junction between two nerve cells, that have a minuscule gap across which impulses pass by diffusion of a neurotransmitter. Our brain could be thought of as one giant electrical membrane full of tones and patterns that change when the resonance of our cell's changes based on their shape and how active they are. He then showed me my favorite project to this day, **Lisa Park's, Eunoia II.**

“Eunoia II is a project created by Lisa Park who formatted the use of brainwave sensors with this piece, which is inspired by Baruch Spinoza's definition of human feelings, that are broken into 48 categorizations. In his book Ethics, he describes emotions as, “States of mind and body related to feelings,” and says that “all emotions are derived from three primary emotions: joy, pain, and desire. He lists 48 different forms of emotions, which include hope, fear, confidence, despair, hatred, remorse, overestimation, contempt, compassion, humility, pride, despondency, shame, benevolence, anger, etc. “

After two years of taking music and audio programming and dance classes, all I could think about were these displays of art that were linked with our human consciousness.

I became extremely intrigued by the potential ways that our brains could be wired when I was made aware of the term, “Synesthesia.” I had only briefly heard Alexander Scriabin's name in my Music Composition classes as we discussed the different ways that musicians would write music. When I started to research the mathematical link between sound to light conversion, I found a series of numbers that synced up a specific colored ray of light, to a specific tone that could then be mathematically converted to a specific note on a piano. I was able to find a website that had many images and lists and a calculator available to convert sound frequency into color rays and even temperature.

What is Neuroscience?

1. any or all of the sciences, such as neurochemistry and experimental psychology, which deal with the structure or function of the nervous system and brain.
2. Neuroscience is the scientific study of the nervous system.

When I began learning about Neuroscience, I was a very young girl. My father was diagnosed with Multiple Sclerosis

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when I was 11 years old after my family spent a really rough six months away from my mother while she found us a new home in Alabama. My father was having problems with his emotions to the point to where he said he would physically see the color red when feeling enraged. He also claimed that he would have double vision when he turned his eyes to look to the right. I was too young to understand that this was the first true sign of his neurodegeneration. After running a few tests and receiving an MRI, his diagnoses was finalized. The nurse had screamed at the images of lesions that had started to occur in his frontal lobe. Depression, anger, detachment, and feelings of hopelessness started to plague his mind and our life as a family.

The doctors recommended that we educate ourselves about the disease. My father lost his job within the next two years because he was not able to perform his work functions correctly for an eight-hour day period. It was three years after my father's diagnoses that my mother had a mastectomy to remove cancer in her lymph nodes. She suffered from overwhelming stress while my brother and I began to fail in school and our dad started to separate himself from us completely as a family member. We were all broken and lost within our circumstances and couldn't be emotionally available for each other. My father began therapy for his depression. He would talk about the memories of his siblings. He was the youngest of seven brothers and sister. His mother had passed away when I was ten. Just one year before his diagnoses. Seeing my dad's ability to find enjoyment in things start to decline was the hardest experience I had to cope with. When one family member feels so helplessly detached that they isolate themselves entirely from the world, then the rest of the family will need help in formulating an understood care plan for their family member's health. My dad had no one to talk to at the worst point of his mental health with his disease, and so my family fell apart in accusations.

When I was able to visit my family last year in 2017 for Thanksgiving, I saw my dad for the first time in about three years. My mom let me borrow her car to go and see him. My brother and she were not speaking to him at all because they felt like he was invading their lives by trying to continue to come in their home and take back his belongings, which included my grandfather's oil paintings, and the portion of the house that he originally signed for. He didn't seem to consider the couple of years of alimony that my mother paid him when they divorced after I was released from a troubled adolescents' therapeutic program. When I saw my dad, he had lost his ability to control the movement of his eyes. They were rolling around in his head like bowling balls. He has also lost his ability to write.

Thankfully, I can still talk to my dad about writing in code. His intelligence is still apart of him through his cognitive decline. He has more sensitivity in his senses due to the lesions in his brain, but the gaps have not taken him away from his individuality or intelligence. It has left room for him to be able to develop new, significant thought processes. When I tell him of my struggles he says, "I really wish I could help you, but I just can't," and I let him know that being able to talk to him is all the help I need for the time being. It was

recently made clear to me in the last phone conversation that I had with my dad this past November 2018, that when he said this again it seemed to be in the way of, "I wish I could be more of a father to you, but I just can't," and not in so much a way that he didn't have resources or the ability to help me. My dad's cognitive ability was just limited to his sporadic thoughts and memories which I love listening to. His intelligence remains in the depths of his neurons.

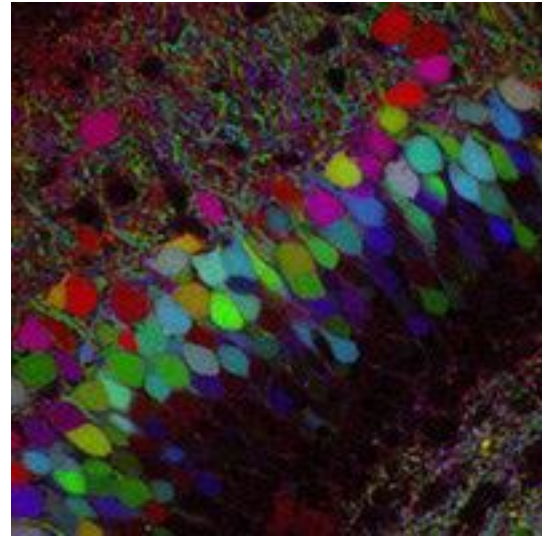
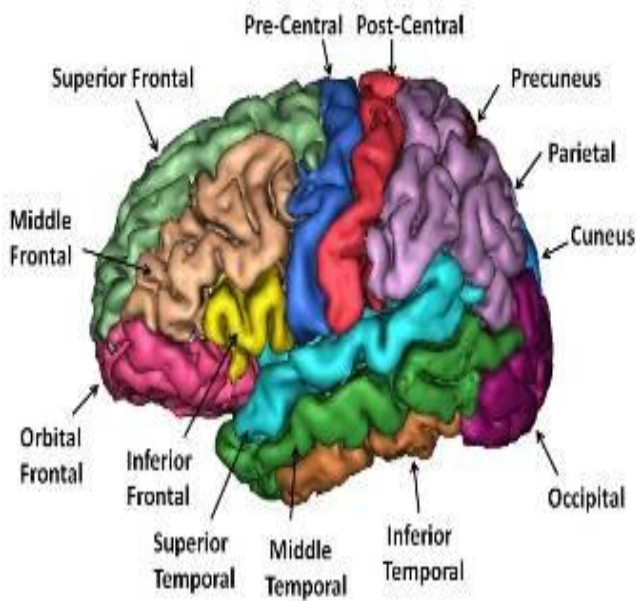
"Negative correlations between areas of frontal and parietal lesions and performance on tasks requiring sustained attention and working memory have also been found in patients with MS"

Upon learning about my father's agitation towards tasks that require too much-sustained attention, I also noticed a similar trait in certain individuals I would come across, almost more often than not, as I was exploring through my life. I have met many of these individuals, at rock concerts, my workplace, school, even just randomly about at grocery stores. I did not know that they were survivors, living with Cerebral Palsy. When I started to learn about the lifelong struggle's they faced in just being able to function normally, I saw so much relation to how my father's body started to react towards the slow degenerative disease and how their bodies reacted to the conditions they were faced with in developing the long-term cognitive ability. At this point, I could see our raw human form in layers and visualize how the data that makes up our animalistic physique could be a detailed project to continue working to develop.

"Cochlear implants are two-piece **devices**. ... Typically recommended for **cerebral palsy** patients with moderate to complete hearing loss, cochlear implants bypass damaged parts of the auditory system, stimulating sounds. Surgery for cochlear implants takes about two hours, under general anesthetic."

This is where physics gets really interesting. When I began learning about the technology devices that were created to help these individuals in developing communication skills, I knew we had found the missing link between our brain synapses and our physical cognitive function. If we can harness our abilities to communicate by transmitting signal flow through our neurons with a technical device, then we should be able to also find a way to add simulation enhancements to create signal flow in certain areas of our brains where cognitive inability might be affecting our mental and bodily functions.

How is our Brain Mapped?



The Human brain is an organ containing 100 neurons and support cells that store a lifetime of memories. Scientists have worked to develop many methods in which are used to map the human brain today. Some of these include:

- **Computer axial tomography (CAT) scan**
- **Structural [magnetic resonance imaging](#)**
- **Diffusion tensor-MRI (DTI)**
- **Diffusion tensor-MRI (DTI)**
- **[Positron emission tomography](#) (PET)**
- **Functional MRI (fMRI)**
- **Pharmacological functional MRI (phMRI)**
- **Transcranial magnetic stimulation (TMS)**

Each of these methods of mapping our neurons has allowed us to take countless images of our brains over the past century and has allowed us to visibly see what cognitive decline can look like both in aging and faced with the disease. It has allowed us to recognize the cognitive decline in a measurable physical format. With these technologies, we have been able to give more accuracy in our medical diagnostics.

What is the Brainbow?

In today's newly developed techniques of brain mapping, researchers have been able to visibly see all the connections between the neurons in an intact brain. The method for the "wiring diagram" of a brain today, is called a connectome. Researchers were able to see individual neuron cells, but the connectome allowed them to be visible all at once.

Brainbow labels every neuron in an active brain a different color. These images allow scientists to see where and how neurons connect to each other to create this intelligent organ in its entirety. In both growth and aging, they are able to see how the neurons change connections. Brainbow was constructed by using a two-step process that was created at the Washington University in St. Louis, MO, by a group of scientists led by professors **Jeff W. Lichtman** and **Joshua R. Sanes**. A specific genetic design was constructed in the labs that they found could be recombined in multiple arrangements in order to produce one of either three or four colors given, based on the particular fluorescent proteins being implemented. Then, multiple copies of the same transgenic design were inserted into the genome of test subjects, resulting in the random expression of different protein (XFP) ratios that subsequently caused different cells to exhibit a variety of colorful hues.

What is truly amazing is the underlying meaning that is yet to be discovered behind these intricate colorful arrays. Alexander Scriabin's, Clavier à Lumières system seems like it could apply. He developed a map of discreet pitches and colors based on his experience living with synesthesia. Scriabin's system enabled him to place similar colors on notes that were a perfect fourth and fifth apart. When the notes were laid out in the format of a circle of fifths, the colors appeared in a more systematic and continuous manner. In August 2016, Nicholas Melendez produced a chart that he developed independently based upon his own calculations. The colors on the chart matched perfectly with the colors produced by the Pitch-to-color calculator that is accessible through "Manifest Spirit Music's" website. These calculations could easily be added to this diagram to produce more accurately mapped results.

What is our brain's electrical current?

Electricity is everywhere. One of my favorite inventor's, Nikola Tesla, was able to prove through his research and designs that electricity runs through the human body as well. Our cells are designed to conduct electrical currents, making it possible for us to think, move and feel. Electricity is required for our brain to send signals to our nervous system throughout our body. Our bodies contain elements like Sodium, Potassium, Calcium, and Magnesium that all have a

specific electrical charging component. Most of our cells use “Ions” to generate electricity. What’s interesting about the cell membrane is that while it functions as a barrier to molecules, it also enables a cell to generate electrical currents. Resting cells become negatively charged on the inside while their outside environment is positive. This can happen when there is an imbalance between positive and negative Ions both inside and outside the cell. This charge separation happens when charged Ions are allowed to flow from the inside and out of a cell membrane. The flow of charges through the membrane is what initially generates electrical currents. A disruption in electrical currents is what leads to illness.

“In order for the heart to pump, cells must generate electrical currents that allow the heart muscle to contract at the right time. Doctors can observe these electrical pulses in the heart using a machine, called an electrocardiogram or ECG. Irregular electrical currents can prevent heart muscles from contracting correctly, leading to a heart attack. This is just one example showing the important role of electricity in health and disease.”

In Tesla's writings, "The Problem of Increasing Human Energy," He talks about James Dewar, a Scottish Physicist, and Chemist, who invented the Vacuum Flask. He had discovered in his experiments with liquid air, that germs of organic life are not destroyed, no matter how freezing the temperatures. He discovered that the cells could be transmitted through interstellar space. Tesla mentions that even though human life is incomprehensible, we at least know that it is a movement of nature. He states that the existence of movement implies a mass that is being moved and in turn a force that moves it.

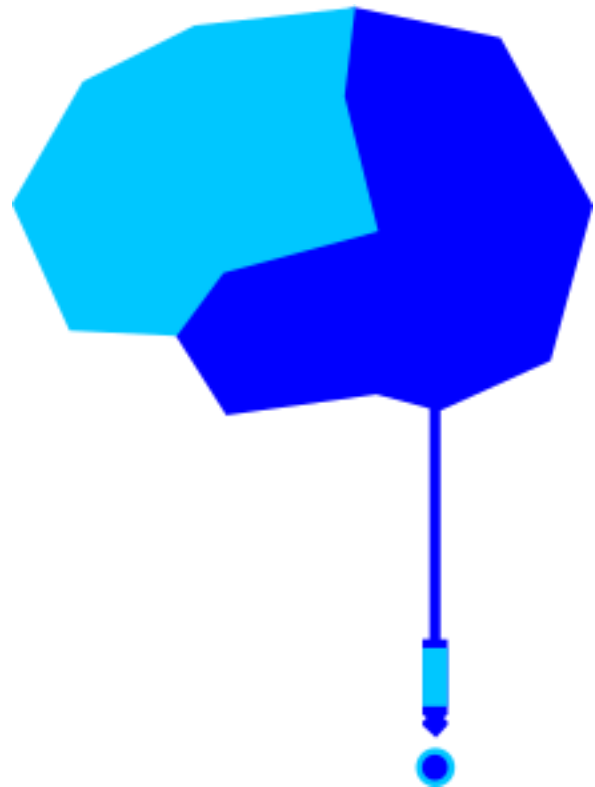
“Birth, growth, old age, and death of an individual, family, race, or nation, what is it all but a rhythm? All life-manifestation, then, even in its most intricate form, as exemplified in man, however involved and inscrutable, is only a movement, to which the same general laws of movement which govern throughout the physical universe must be applicable.”

I believe Tesla was able to find the meaning of our existence through his experiments. He was able to create a projection of a new world from the depths of his mind, by implicating the thoughts and discoveries of his fellow physicists, philosophers, and chemists of the 18th and 19th centuries and beyond. He was able to display in so many ways, the cognitive function of life itself.

What is the EEG Synth?

“In the past, EEG systems included pen-on-paper EEG recorders to trace a representation of sensed brain wave activity on a strip of paper. This produced varying amounts of auditory noise that corresponded to the amount of brain wave activity which was used by medical technicians monitoring a patient.” **Digital EEG Noise Synthesizer**

The **EEG Synth** is an Open-Source Code in **Python** that provides a real-time interface between open-hardware devices for electrophysiological recordings as well as analog and digital devices. It enables a user to control technology devices in real-time by using an individual’s electrical brain and body. It was a collaborative project that came together during workshops and through performances in Stockholm, Paris, Athens, San Diego, and Tucson. It is originally designed by Neuro-Scientist Stephen Whitemarsh as well as the Swedish Musician and Visual Artist Jean-Louis Huhta and Per Hüttner.



Since the first session of the experiment on November 2014, the team has branched out into many areas of study that involve neuroimaging and mapping of our movements with algorithms programmed inside of a computer. These discoveries have already shaped the past four years of our ability to create stronger methods of running diagnostics in order to create stronger methods of treatment.

II. SUMMARY

Self-Care is a lifelong process that becomes harder to teach when you are not able to find a passage through to understanding. The human mind is such a magnificent source of information that can be trained to accomplish imaginable tasks. When you start to lose your ability to perform efficiently, then you are left to both learn and redesign your systematic way of doing things. In remaining active and aware of your physical and mental capabilities, you can begin to achieve success within the essential functions of the Cogwheels of Brain health that were learned in this class upon reading the book, “Strong Brains, Sharp Minds.”

Stress Management is essential for maintaining cognitive

function. In cases where an individual may be experiencing Post Traumatic Stress Disorder, it is important to calmly direct the situation into a field of positive understanding through structured communication tactics. In maintaining Stress Management through self-care, it is important to remember the extent of your abilities in being able to acquire your needs through physical or communicative means.

Physical Exercise is a key to maintaining healthy cognitive function. Life is based around movement. When we stop moving, we stop existing for a moment externally, but the cells in our genetic makeup are always moving. The more we are able to keep positive charges running through them, the more stable they will remain as they to experience rebirth, growth, and death.

Mental Development is the process in which we grow and strengthen our brain structures so that the electrical connections in which we function are able to sync up in a working manner. To change the way, you think will enable one to change the way they function and eventually develop a completely new system of movement.

Social Engagement is a part of natural life function. Cells will become isolated in freezing temperatures but can grow an entire ecosystem within years in becoming active and reproduction. We are meant to communicate with others. The energy inside of us is infinite and we can't escape it's ever changing movement.

Diet and Nutrition are important factors to consider in remaining stable with our cognitive function. I was able to learn about the conditions of living with a restrictive diet through a friend, Vance Smith, who gave a speech to the University of Louisiana about his experience in living with Liver Cancer. He had a list of foods, kinds of vinegar, supplements and concentrates that kept him alive to be in my life for over twelve years.

Sleep and Mental Rest are what enable us to consolidate our memory and learning abilities. Our neurons and body cells are able to repair and grow when we allow ourselves to have moments of rest. When we rest, the information from what is shown to us throughout our day can be processed

REFERENCES

- [1] <https://www.youtube.com/watch?v=vvJAgUBF4w&t=12s>
- [2] https://en.wikipedia.org/wiki/Ernst_Chladni
- [3] <http://www.thelisapark.com/eunoia-ii/>
- [4] https://www.flutopedia.com/sound_color.htm
- [5] <https://www.google.com/search?q=Dictionary>
- [6] <https://www.sciencedirect.com/science/article/pii/S088761770700100X>
- [7] <https://cerebralpalsygroup.com/treatment/assitive-devices/>

- [8] <https://science.howstuffworks.com/life/inside-the-mind/human-brain/brain-mapping.htm>
- [9] <https://www.labroots.com/trending/neuroscience/250/researchers-call-brain-anatomy-differences-between-autistic-and-typically-developing-individuals-indistinguishable>
- [10] <https://www.graduate.umaryland.edu/gsa/gazette/February-2016/How-the-human-body-uses-electricity/>
- [11] <http://www.tfcbooks.com/tesla/1900-06-00.htm>
- [12] <http://www.eegsynth.org/>
- [13] <http://stephenwhitmarsh.com/>
- [14] <https://www.beatport.com/artist/jean-louis-huhta/25965>
- [15] <https://www.perhuttner.com/>
- [16] <http://www.mindramp.org/blog/five-ways-to-keep-your-brain-healthy-and-prevent-dementia>