Unlocking the Inner Genius Within

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Abstract

People with savant syndrome are characterized by rare intellectual gifts in one or more specific areas. Acquired savant syndrome occurs, in most cases, after a Traumatic brain injury (TBI) and is associated with the development of frontotemporal dementia (FTD). Specifically damage to the left temporal lobes caused by FTD has been linked to the acquisition of savant skills. The left-right compensation theory explains the process responsible for acquiring new abilities. It explains that the inhibition of pathways on the left side of the brain, specifically the temporal lobes, can cause compensatory growth on the right side of the brain. Allan Synder's experiment utilizing transcranial direct current stimulation (tDCS) demonstrates this theory utilizing low levels of electrical current targeting the left region of the brain to stimulate the formation of new neural connections on the right side. Relatively new technologies and current research is promising to understanding acquired savant syndrome and gives light to possibilities of unlocking one's inner genius.

Introduction

For much of his adolescence Jason Padgett, a college dropout, lived a typical party life and had no interest in education, especially mathematics. All of this changed when he suffered a blow to the back of his head during an attack outside a bar one night. Padgett was rushed to the hospital and diagnosed with a concussion and a bleeding kidney. It was not long after his return home that he noticed his behavior drastically changed and that he was seeing everything from a different perspective. Padgett stated, “water coming down the drain didn’t look like it was a smooth, flowing thing anymore, it looked like these little tangent lines” (Keating, 2020). For the first time in his life, Padgett was observing everything through a peculiar lens and he knew something was quite strange. He turned to the internet with hope of an explanation to the unique vision caused by his trauma, but was unsuccessful. Oddly enough, he was finally able to explain what he was seeing with drawings, which are commonly known as fractals, or repeating geometric patterns. He realized that he acquired a rare talent for physics and mathematics in particular. Most fascinatingly, he is the only person known to date who can not only see, but also draw fractals.

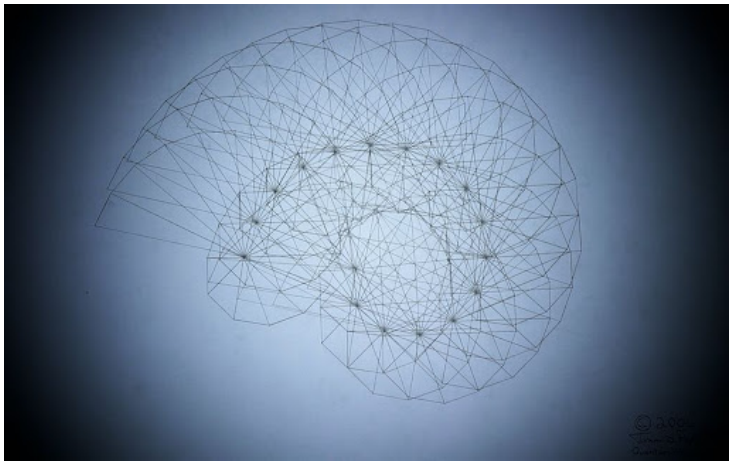

Figure 1. One of Jason Padgett’s hand drawn fractals, Quantum Nautilus. It describes the fact that all things in the universe are in constant motion and rotating around something else (Padgett, 2006)

Savant Syndrome

Jason Padgett is believed to have acquired savant syndrome. Savant syndrome is a rare condition in which people, typically who are mentally impaired, demonstrate remarkable talent. Less than 1% of individuals have been diagnosed with savant syndrome, but it is estimated that 1 in 10 people who have autism have some level of savant abilities. The characteristics of acquired savant syndrome are parallel to people with autism who have savant syndrome. The major difference is that acquired savants discover a prodigious ability that laid dormant after suffering traumatic brain injury (TBI). A TBI is a disruption in the normal function of the brain caused by a sudden injury that causes acute and irreversible damage to the parenchyma (Ng and Lee, 2019). The most severe forms of TBI can cause permanent damage and lingering side effects. Common side effects include headaches and loss of memory as well as consciousness (Argawal et al., 2020).

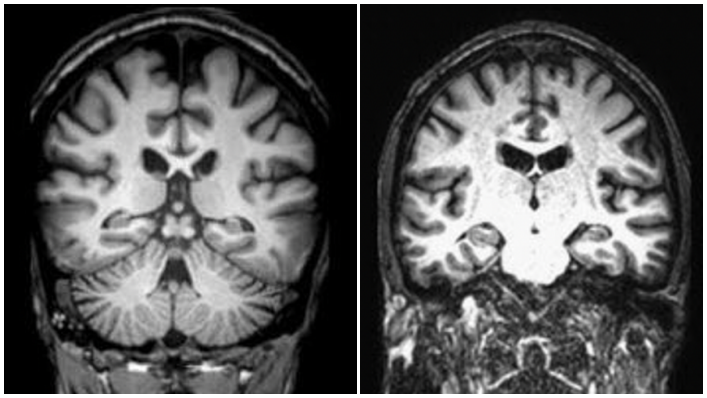

Figure 2. A comparison of coronal MRI scans demonstrating the differences in a savant (right) (Padmanaban et al., 2020) and a non savant (left) (Corrigan et al., 2012), specifically in hippocampi.

Connection between traumatic brain injury and acquired savant syndrome

While many side effects are common with TBIs, it is a particularly high risk factor for developing Frontotemporal Dementia (FTD), a deterioration of the frontal and temporal lobes. The frontal and temporal lobes of the human brain are highly developed and serve as a major differentiator

between the abilities that humans and non-humans have. FTD is typically a language or behavior disorder and affects the anterior temporal lobes (ATLs) which are the center for semantic knowledge or general information that one has acquired. The orbitofrontal cortex which is involved in social and emotional behavior is also targeted by this disease (Young et al., 2017). This specific deterioration has been unexpectedly linked to the acquisition of savant-like talent (Heaton & Wallace, 2004).

Not only is FTD linked to savant syndrome, but it seems that patients with FTD affecting the left-temporal lobe are most likely to acquire savant syndrome. A research study which investigated patients with newly acquired savant-like skills in the early stages of FTD determined that 4 out of 5 patients had the left-temporal variant of FTD. In an earlier research study, the inhibition of certain signals, specifically from the left hemisphere of the temporal lobe, was found responsible for inducing savant-like capabilities (Miller, 1998). A plausible explanation for this occurrence is the left-right compensation theory that states the inhibition of the left hemisphere can cause compensatory growth in the right side of the brain (Snyder, 2009). The formation of the new connections in the right region of the brain fosters new abilities and causes a burst of creativity.

Although savant syndrome activates specific parts of the brain through formation of new neural connections, it destroys others. People who acquire savant syndrome are rare cases of geniuses, yet most have encountered behavioral disorders connected with TBI. In Jason Pagdett's case, his TBI brought on obsessive compulsive disorder, specifically germaphobia and agoraphobia (Keating, 2020). This presents the fundamental question of whether we can tap into and become geniuses without the side effects of TBI. Looking into these possibilities, Allan Snyder, a neuroscientist at the University of Sydney, conducted an experiment using transcranial direct current stimulation (tDCS) to induce changes to cortical excitability of the left hemisphere of the temporal lobe. The subjects were asked to solve a critical thinking puzzle known as the "nine-dot" puzzle before tDCS yet all were unsuccessful. During the tDCS, 40% of participants were able to solve the same intellectual challenge (Chi & Snyder, 2016). Like people who acquired savant syndrome, the participants of this experiment expressed a unique ability that was not present before (Piore, 2013). This experiment not only demonstrated the possibility of localizing regions of the brain responsible for savant-like talents, but it also shed light on the possibility of unlocking one's inner genius.

Figure 3. Professor Allan Synder displays the device used to electrically stimulate the brain, commonly referred to as the "thinking cap" (Wynne, 2011).

Similar to acquired savants, participants of Allan Synders experienced discernible changes in their neural activity. The tDCS forced redistribution of electric circuits in the left hemisphere and in turn allowed stimulation of neurons on the right side. Although for acquired savants, damage to the temporal lobes is what ultimately allows "rewiring" of neural pathways and domination of the right hemisphere (Stan-Missouri, 2019). The ability of the brain to empower neurons to form new connections is known as neuroplasticity. That is what neuroscientists believe is responsible for the expression of a new ability that otherwise was not present, or "hiding".

Currently, tDCS is available online for a fairly cheap price and its popularity is steadily growing. In recent studies, tDCS constitutes a promising therapeutic intervention for psychiatric disorders such as people with major depressive disorder (Bennabi and Haffen, 2018). Commercial headsets have become available as well and are just one click away from users. The headset's stimulation encourages the brain to form new connections enhancing users' process of learning. Professional skiers of the Olympic National team train using electric stimulation headbands known as halo (Yuhas, 2018). Targeted audiences for companies selling tDCS also include the average student who wants to perform better in their next exam although neuroscientists have raised concerns about this practice. There are still many unknowns to what long-term side effects tDCS can have after repeated use as well as how the other regions of the brain will react. Emiliano Santarnecchi, a neurologist at Harvard medical school, also emphasized that each brain is different and that individuals may react differently to the stimulation (Yuhas, 2018).

Figure 4. LIFTiD, a commercial tDCS device available that recommends 20 minutes usage a day to maximize attention, focus, and alertness (RPW Technology, 2022).

Future research and Outlook

Despite this remarkable technology, the tDCS has not allowed people to acquire prodigious capabilities similar to the abilities of people with savant syndrome. With this being said, there are still many things about savants that are yet to be fully elucidated. Given the low prevalence rate of extraordinary savant skills, there have been limited studies including savants. While this is a setback, technology that is more sophisticated, like tDCS has allowed researchers to learn more about the brain functions, thus giving more insight to acquired savant syndrome. Through a relatively new approach to the positron emission tomography (PET) called ambulatory microdose positron emission tomography (AMPET) researchers have been able to understand more about brain activity during various activities (Freeman, 2015).

The AMPET is a wearable scanner that allows for imaging while the patient is able to freely move and perform various tasks. Experiments and innovations like these are not only promising in understanding more about the brain functions but also savant syndrome and in helping people who suffer from brain damage.

The possibilities are endless with new neurotechnology that is being developed. Neuralink corporation founded by Elon Musk is currently testing implantable brain-machine interfaces. This chip's purpose is to help paraplegics perform simple tasks that they otherwise would not have been able to complete. Clinical trials have shown promising results with rodents and monkeys and a study is ongoing with human participants. In the near future, this technology could be revolutionary and the missing piece to helping people "unlock their inner genius."

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