

Weak Electric Stimulation: An Answer to the Unremitting Voices in a Patient with Schizophrenia?

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Imagine yourself sitting in an auditorium by the window that overlooks a cricket ground. Then imagine your overwhelming passion of hearing your favourite musician or artist perform your beloved piece being overridden by the chaotic shouts and screams coming through the window. How miserable that state would be for a passionate music lover? Multiple this agony and anguish hundreds and thousand times, and you will have the feel of what it is like to be a patient of schizophrenia who hears voices.

This profound experience of a patient who can hear voices, to an otherwise unaware observer raises several questions in the latter's mind. How can someone be convinced that he/she is being spoken to or with, when he/she can clearly not see anyone at all? Well, a trained psychiatrist would tell you that there are many other unbelievable experiences, but hearing of voices, that is, auditory hallucinations, is one of the most common complaints of the sufferers.

Medical science has worked unbelievably hard to help these patients. Every decade, newer and newer medications are introduced, but the question that has been troubling scientists over the world is that have we succeeded in truly dealing with this challenge? Have we actually pulled these patients away from the edge of the slippery hill-top that otherwise lands them into misery, identity crisis, mirage of a reality and the everyday battle of proving their story to a reluctant "healthy" world?

But, wait. This dramatic prologue does have an interesting afterthought. The challenge of meeting the medical and psychiatric needs of this group of patients has led to the exploration

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of different treatment protocols in addition to the conventional standard medicines. Given the opportunity of being part of a group of highly inspired and passionate researchers involved in a similar scientific adventure, I decided to explore one such treatment procedure called the transcranial direct current stimulation the tDCS. If the word “stimulation” has thrown you off-guard, then do not panic. You will know the “how” and “why” about it, once you understand what we are trying to achieve in the first place.

Information in our brain is exchanged in two forms. Neurons, which are the fundamental brain cells, communicate with each other through two “courier” services. One is through the chemicals and the other is through electricity. Please do not hold your breath at the second word, for it is this very electricity that switches on/off our movements, our thoughts, our vision, our touch in our day-to-day life. These chemicals and this electricity work in harmony to provide us the experience of the world we are living in today. Look at them as ultimate message providers, communicating information from one end of your body to the other. It is, therefore, needless to say that any nudge to this well-balanced consortium can end up a person with losing his control over the communication in between his different body parts, making him a stranger in his own body and world.

Medicines help these patients by bringing the equilibrium to the chemical imbalance. And it is quite apt to say that they work wonders in most of the cases. But, what if the neurons of our brain are unable to avail the electricity’s courier service? In simple words, what if the neuron wants to fire an electric impulse and for some reason is not able to, and we help it with just that? What if we do a little favour to the electrical courier service?

Well ECT, also infamously known in our culture as the “shock treatment” basically works on this principle. In simple words, it literally excites the neuron in question, to that point where it fires electric current. And that serves a purpose of awakening a sleeping neuron or disciplining an overacting one. But, although extremely therapeutic, it has been repeatedly found to cause memory loss or poor focus in activities.

So the scientists thought, what if we do not excite a neuron to fire, but rather just bring it to a point from where the neuron would choose to fire if the activity called for it? This way, the neuron would not fire pointlessly and it would have no trouble conducting the electrical information if it needs to. This is akin to saying that we take a horse to a pond and wait until it is thirsty enough to drink the water. This is unlike to what is done in ECT, where we make the horse drink the water by assuming that it is thirsty.

And so here is where brain stimulation techniques like tDCS come into the picture. This technique when used effectively helps the neurons to reach a certain point of electrical threshold, from where it is easy to conduct an act for the neuron in times of need. The ball then is in the neuron’s court! It communicates only when there is a need, or when it has to!

The beauty of this treatment is reflected in few very well-designed research projects over the world. Especially in the context of the patients who are distressed by the constant herald of voices, this treatment has found an impressed audience. These studies first delved into understanding what is wrong with the brain. That is to say, they looked into which area of the brain is overactive and

which area is relatively underactive in patients complaining of “hearing of voices”. They realised that a certain part of our brain, the one which is present underneath the skull, a little above and behind our left ear, has increased activity in these patients. This part of the brain is called the temporo parietal junction aka the left “TPJ”. Interestingly, they also found that the part of the brain lying underneath the left forehead has decreased activity. This part is referred to as the left dorsolateral prefrontal cortex, aka the left DLPFC.

So quite smartly, they decided to bring balance to this by decreasing the neuronal communication in the left TPJ and increasing the electrical courier service in the left DLPFC. Using basic physics knowledge, these scientists placed negative cathodal electrode over the left TPJ to inhibit it and placed positive electrode anode over the left DLPFC to stimulate it. Using a small direct current machine that was set for 20 minutes per one treatment session, patients were given 2 mA of current for two sessions every day for 5 days. To check if the patient has actually improved or not, they scored a questionnaire about the “voices” before initiating this treatment and compared the scores after the treatment. It was found that a fair amount of patients showed remarkable improvement.

These studies made a fairly strong comment on the potency of this treatment. But as luck would have it, a newer question clouded us as scientists. What if some patients only have increased activity in their left TPJ brain area? What if we do not want to improve the electrical courier service in left DLPFC since it is doing its job quite fine. Since the direct current machine would expect us to stimulate one part of the brain while inhibiting the other, I hope you realise we would not be able to help this group of patients using this machine.

To deal with this new challenge, my team has been working on a newer advanced research project called the HD-tDCS, an advanced or the high-definition version of tDCS. This is advanced in numerous ways. It has smaller electrodes, thus giving us the privilege of targeting a specific part of the brain (making sure we target only left TPJ). Also, in this technique the electrode of interest has the current of our desired caliber which is 2 mA, effectively disciplining the electrical courier service in the left TPJ area, while the return electrode is subdivided into 4 parts (0.5mA current each), making no one return electrode capable enough to tamper with the electrical activity in the underlying brain area.

Our study with this HD-tDCS treatment has found very exciting and promising results. Most of our patients have shown benefit of roughly more than 20% from this treatment. Majority of the patients reported decrease in the frequency of the voices they heard, while some reported that the quality of that experience after the treatment was less overwhelming as compared to before the treatment.

Though the science of using electricity from outside to manipulate the electricity in the brain of a human being isn't very new, its application for therapeutic requirements of the patients is still in its early phases. Our study has been able to make a subtle comment on its promising use in future, but we need more rigorous work in this area to ascertain its use with better confidence. Perhaps, we are all moving towards that point where finally we will be able to learn the perfect troubleshooting methods to bring harmony to our brain's ever functioning, diligent and kindhearted courier services!