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Responsibility: Revis(ion)ing Brains via Cognitive Enhancement

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ABSTRACT
In this paper, I will explore the unique ethical issues attendant to cognitive enhancement, which is the augmentation of one's intellectual ability via medicine or various methods of therapy, especially transcranial direct current stimulation (tDCS). I start by introducing tDCS and noting its rise in popularity, along with its growing fervor in the DIY community. I then review and expand on some of Dr. Anjan Chatterjee's concerns regarding "cosmetic neurology," including, but not limited to, whether cognitive enhancement is worth the potential risks, and the question of if we have the ability to enhance, should we enhance, as well as if—through the use of cognitive therapy—we could be "altering an individual" and "eroding their character." I delve further into the personal realm with the unique perspective of a first generation student and additional cross-cultural considerations. I will begin by exploring issues of physical safety and efficacy. To this end, I will review some experiments done with adults and children using tDCS—though their results lend credibility to tDCS not having significant enduring effects, I cite Dr. Martha Farah's work regarding why these studies' results may be inaccurate and why further studies are needed to accurately view the efficacy of tDCS. Next, I will discuss some non-physical harms such as threats to autonomy and authenticity. Following the Maslen model, I question whose responsibility it is to allow enhancement (and at what age), under which circumstances, and when can its use be justified. I broach questions such as 'if someone is chronically on a drug, are they still the same person making the same choices they would normally' and whether their 'quality of life would be better post enhancement?' Finally, I ponder tensions between coercion and responsibility: if the stakes are too high and if, in the competitive culture today, not using some type of cognitive enhancement may be detrimental to a child's success. Thus, it could be conceived a parental responsibility to enhance their child.

KEYWORDS
Cognitive Enhancement, tDCS, Noninvasive Brain Stimulation, Authenticity, Safety, Responsibility, Implicit Coercion, Open Futures, Cosmetic Neurology, Treatment

I'm here today to tell you about an incredible opportunity that has many implications for the near future. While this opportunity has a wide range of ethical issues surrounding it, it has the potential to transform our lives for the better and this opportunity is termed cognitive enhancement. There are several forms of cognitive enhancement you may have heard of, including the pill form—mainly Ritalin, Adderall, and Vyvanse (Farah 2015, 379-380). Other forms of cognitive enhancement include tRNS (transcranial random noise stimulation) and the most notable form of electric stimulation is transcranial direct current stimulation also known as tDCS. tDCS is a noninvasive brain stimulation that is becoming increasingly popular since it uses only about 1 milliamp electric current to stimulate specific regions of the brain to excite neuronal activity and generate mental sparks—figuratively—if you're doing it right (Sarkar et al. 2016)! It's not only available to buy as cheap as $50, but there's also videos of college kids on youtube zapping themselves and a robust Reddit community with their do-it-yourself tDCS, which consists of two sponges hooked up to a 9 V battery!

I'm going to tell you what tDCS is and you're going to be shocked and ask me- what? that's incredible! why are we not doing this at this very moment, and I'm going to ask you to keep in mind three ethical issues: 1- safety, 2- responsibility, and 3- authenticity. But there is a lot of literature out there on adult studies, so I'm going to hone in on cognitive enhancement with the focus being the child.

Most every parent wants his child to grow up and be successful, whether that's a teacher, the next gen Mark Zuckerberg, or a neurosurgeon. That was especially true in my case, as a first generation student in America. When I was two, my parents came to the United States, "the land of opportunity," seeking the success that they had only heard about in India. I grew up hearing their stories of hardship when they first moved here with an infant, without a car, and very little working English. I witnessed them struggle tirelessly to make a life for themselves and they always said that *without education you are nothing and will be no one*. As a child, while my friends would go to sleepovers and camping trips with friends, my dad would spend time checking my math problems on the white board at home and my mom would make me spell 50 words correctly every night. But even with all that pressure, I never had the best GPA, I had to work pretty hard to stay on top of my classes, and I always fell short of their expectations. So given the opportunity, would my parents have tried to enhance my cognitive ability?

The question then becomes, to enhance or not to enhance. Dr. Anjan Chatterjee, a professor of Neurology at UPenn, asks, "If we have the ability to make brains better, should we do so when there is no acute 'disease?'" He calls such enhancement administered by the neurologist "cosmetic neurology" (Chatterjee 2004, 968–974). By definition, "enhancement" is a moving target so we usually characterize that which is in need of treatment is known as disease, whereas that which is only *modified* is known as enhancement. There has been much debate concerning the line between therapy and enhancement and whether enhancements go beyond the purpose of medicine (Chatterjee 2004, 968–974). However, medicine *does* include treatments that are not necessarily intended to cure or prevent illness. For example, plastic surgery and contraceptive medications are allowed, though they are not *treating* anything per se. On the other hand, there are also many "enhancements" that have no proven medicinal value, like dieting pills and energy drinks.

So going back to our three ethical issues with cognitive enhancement, we see that the first, and perhaps most obvious concern, is safety. Though over 10,000 trials of tDCS testing cognitive improvement in adults have been performed safely, because it is such a new field, little is known as to the long term effects (Fregni et al. 2015, 22-35). Moreover, the effects of tDCS (like improved memory and concentration) are relatively short lasting, so it must be applied repeatedly to have a significant effect (see Kincses, Tamás Z.et al. 2004 and Fregni, Felipe, et al. 2005). Some might suggest that the reversibility of the effects, or shortlasting nature of the effects, make the device relatively safe, but who knows if we're doing more harm than good when these devices are used in healthy individuals with repeated use. Even greater concerns for safety come into play when considering how such use impacts the developing brains of adolescents and young adults (Moliadze et al. 2013). On the other hand, tDCS has been shown as a potential effective therapy in the case of depression, anorexia, dysphagia and even stroke treatment (see, for example, Palm, Ulrich, et al. 2009, Pisegna et al. 2016, Kekic et al. 2016). Its potential uses are for applications in clinics and for enhancement of multiple domains of brain function in healthy individuals. Dr. Chatterjee notes that "in disease states one weighs risks [like death] against potential benefits," but he asks whether enhancement is worth the risk in healthy patients who simply wish to become even better (Chatterjee 2004, 968–974).

Dr. Martha Farah, a renowned cognitive neuroscientist, notes that much of the research currently published on existing *pharmacological* enhancers may need to be taken with a grain of salt, because a) enhancement outcomes *in laboratory experiments* differ based on biological and psychological traits of the user, and b) many studies used small sample sizes that could have easily led to false conclusions. Hence, there is variability when calculating its effectiveness. This is also the case with tDCS (Farah 2015).

One study done by Dr. Kadosh, an acclaimed neuroscientist at the University of Oxford, studied the effects of applying tDCS over one week (Kadosh, Roi, et al. 2010). They "electrically stimulated 19 adult participants as they learned a new numerical system by trial and error." They asked the participants to figure out a new numerical system by asking them to pick the higher numbers when stimuli came on the computer screen, where a cylinder might represent the number 5 and a triangle would represent 9. 'All participants wore electrodes on their scalp during these training sessions.' One group received electrical stimulation to the posterior parietal cortex, which is involved in numerical cognition. Another group received stimulation of the dorsolateral prefrontal cortex, which is involved in learning and working memory. "A third group received sham stimulation that caused a slight tingling of the skin but no change in brain activity." At the end of this weeklong study when all participants were given a final *new* task, they found that those whose parietal areas had been stimulated learned the numerical system the *most quickly* but their *reaction times were slowest* when applying that information to a new task. On the other hand, those who received stimulation to their prefrontal area were *slowest* in learning the new system, but performed "*faster* on the new task at the end of the experiment." Thus, at least in this case, there were both benefits and some drawbacks to receiving electric stimulation (Kadosh, Roi, et al. 2010).

Even less is known about effects on children and there are a limited number of experiments indicating potential success (Maslen et al. 2014). In one London-based experiment, 12 children with mathematical learning disabilities were given nine 20-minute training sessions, 6 of whom wore the cap (but did not receive stimulation) while the other 6 received transcranial random-noise simulation (tRNS), which is a newer transcranial stimulation method that utilizes a randomly varied current. When put in a video game simulation "the children moved their bodies from side to side to guide a ball on a screen to land at a certain point on a

number line, with the difficulty increasing as they progressed." Results indicated that "children who received stimulation showed greater progress in performance [and reached a 20% higher level on the game] than did the controls" (Geddes 2015, 436-437). This, in turn, leads to another argument regarding benefits versus efficacy. The way we test efficacy in laboratory experiments is by having subjects answer a set of carefully calculated questions or having them perform a specific video game task, but how do we know if those effects are more broadly generalizable to everyday skills, like reading comprehension and test taking? It turns out that in the particular study above, when those same 12 children with mathematical learning disabilities were given a general math exam, they did in fact show significant improvements in general mathematics test scores, but who is to say this is not an exception, and that it was the *tRNS* that was responsible for improving math scores (Geddes 2015, 436-437)? If given a reading comprehension test would they do significantly better than they normally do? The answer is maybe, but we don't know yet.

Now let me ask you this. By not taking advantage of such enhancing technologies will we get left behind? Is it a parental responsibility to enhance their children? Won't we as parents (one-day), want the best for our children? Dr. Hannah Maslen in the UK, delves more into this and argues that because such intervention may include "compensatory trade-offs" or functional cognitive losses, more emphasis should be placed on parent's judgment *if* the child has a neurological disease and needs treatment. However, *in absence of disease*, then more weight should be placed on protecting the child's autonomy, since one cannot justify the need for and intervention that would not treat a disease but was for the purpose of enhancement (Maslen et al. 2014). But how do you know a child would have wanted enhancement in the first place? At age 10 is she equipped with the information necessary to make such decisions with profound impacts? I know I sure wasn't as a 10 year old. I remember struggling to pick which ice cream I wanted when the ice cream truck drove around the block. Say the child took the opportunity and turned out successful—would she be glad she received enhancement?

The most noteworthy argument here is that children have is what bioethicists often call "a right to an open future." The principle holds that children have certain rights that they can't exercise yet, but they will be able to exercise when they reach maturity. Thus, parents should not take actions that permanently exclude

or prevent the future options of their children, but they should leave them the greatest possible scope for exercising personal life choices in adulthood (Millum 2014, 522-538). To underscore this argument in natural terms, if a parent enrolls their child in French lessons for 8 years, while that child always wanted to learn piano, she 'wasted' that time learning French when she could have excelled in piano. If we take it a step further and say the parents had administered tDCS when the child was younger, such that she grew into a genius at math, but by high school she realized she wanted to be an artist when she grows up, the tDCS may have diminished that creative side of her. And the child wouldn't have so much of an open future ahead of her.

When considering whose responsibility it is to decide if a child should be enhanced, there lies *another* question that's becoming increasingly difficult to answer. Is the decision actually a choice or is it implicit coercion? One perspective on that thought is if little Jimmy is functioning at an average level but you the parent, want him to excel in all his classes with the hope that he can one day go to Stanford, as is the family tradition-- do you enhance him? In this case, does enhancing the child violate the child's right to an open future or does it facilitate an opportunity for a better one?

The other perception is that in the competitive culture today, parents might feel the need to utilize any intervention they can to improve their child's chance of succeeding, particularly when they feel they already have brought their child into a world disadvantaged. In this case, perhaps the parent feels there is no choice, they *must* enhance their child.

Another question worth noting is whether employers will begin demanding the same for their employees. Already, air force pilots are required (and some residents are encouraged) to take Modafinil, a stimulant originally intended to treat narcolepsy and sleep disorders. If the work force continuously demands excellence of its employees, why not expand that and take a form of cognitive enhancement, since certain forms (mainly the pills) can make employees in all fields less prone to error, able to work and concentrate for longer hours, and operate more efficiently (Bostrom and Sandberg 2009, 311-341)! If surgeons and restaurant employees are "coerced" to wash their hands and follow other protocol, this step may not be all that far away.

That brings us to our final ethical issue with cognitive enhancement— that of authenticity: whether the child would be the same person, at the end of the day or

whether "such interventions threaten essential characteristics of what it means to be human" (Chatterjee 2004, 968–974) . If we do modify a person's baseline state or prescribe drugs, then aren't we fundamentally altering a person and keeping them from being who they are, *or* are we instead enabling them to become their best selves? When someone is persistently on a drug or undergoing tDCS, who is to say they would make different decisions if they weren't always on said drug or stimulant? If we believe, as Aristotle says, that our actions define us, then how do we know that we are not, in fact, slowly changing the person and *not just* their temperament or their personality? I personally think that prolonged use of a drug does change a person. Take, for example, the case of antidepressants, which are known to protect people from the adverse effects of stress. The prolonged use of antidepressants could cause someone to make different decisions than they normally might have when they felt stress. If these different decisions lead to different actions, then yes, I think you are altering a person by prescribing them a chronic drug. Others, however, do not share my opinion. In a qualitative case study done by interviewing parents of children with and without cognitive disabilities, it was found that some parents actually justified their child's use of [ADHD] medication and felt that the "drugs were facilitating the expression of their child's identity, not changing it" (Ball and Wolbring, 2014, 345–364). In yet another study, done by Dr. Ilina Singh, who is famous for her work with kids with ADHD, she found that kids in the UK mainly reported that they take Ritalin so they can manage anger and bad behaviors but kids in US reported that they take Ritalin to be more productive and improve academic performance (Singh 2014, 237-240).

Another commonly held perception is that enhancements just augment people's existing capabilities, so they may enable them to lead a more "authentic life" and reach their full potential (Chatterjee 2004, 968–974). For some, however, the concern is that "natural" excellence is worth more than bought talents, which are less admirable. Additionally, if there are shortcuts to excellence, then access to those shortcuts is what determines success or failures, not one's inherent hard work. Moreover, some shortcuts in our society are completely acceptable. For example, it can be argued that performance enhancing athletic shoes and the use of calculators in high school physics promote authenticity by allowing a person to concentrate on more complex challenges that relate to goals rather than spending time developing thick soles or trudging through algebra. But that, then leads us

to wonder if taking enhancements is cheating (Bostrom and Sandberg 2009, 311-341).

According to Dr. Nick Bostrom, whether something is considered cheating is dependent on the context and the rules. "If school is regarded as a competition for grades, then enhancers are considered cheating because not everyone has access to such enhancement. However, if school is seen as being significantly about acquisition of information, knowledge, and learning, then cognitive enhancements may be legitimate and useful" (Bostrom and Sandberg 2009, 311-341).

But I grew up in a culture where short cuts weren't accepted. As a first generation student in America, I used to always question why I received so much pressure from my parents. Now, I realize it's because they just want me to succeed and to not have to struggle the way they did just to put food on the table, so pushing me to succeed in academics was their utmost priority. They knew I wasn't the brightest Crayon in the box, but given the chance, would they have considered cognitive enhancement?

I asked my parents if they would have done so and somewhat surprisingly, they said no. At first they agreed with each other, and said there's always the risk of further complications and you potentially risk more than you can gain. Moreover, they noted that since I didn't have any known diagnosed cognitive deficits or explicit neurological disorders, then no, they would not go for it because it wouldn't be "worth it." Finally, my mom stated that every parent's main wish is that their kids just be safe and happy, and that academic success was only a means to achieve happiness. She would never do anything to threaten that by giving me enhancements even if it means having an "ordinary" daughter when she wanted an extraordinary one, because to her, I am extraordinary.

So now I've told you about the possible benefits of cognitive enhancements and the three main ethical issues most frequently raised with it. Now I want to ask you, if you were a parent raising a child in the competitive culture today, would you allow your child to be cognitively enhanced? Wouldn't you give them any advantage you possibly could to succeed? Is that true for yourself—if you have the chance to do so, would YOU do it? If you close your eyes, can you imagine a generation where everyone, from artists to students and surgeons, is performing at their utmost capacity? Can you imagine everyone with tDCS "thinking caps?" Is this where we are headed?

DISCUSSION

One fascinating question that fellow Emory University student, Lokita Rajan, brought up was whether the use of calculators could be considered a form of coercion. She astutely noted that teachers frequently write exams assuming that students use calculators on math or science exams, and that the time frame allowed for the test assumes the use of a calculator. However, in doing so, are they taking away our free will or are they enabling us to reach our full potential? She was prompted to ask this question in response to my statement that "enhancements just augment people's existing capabilities, so they may enable them to lead a more "authentic life" and reach their full potential." Conversely, one may argue that "natural" excellence is worth more than bought talent. In my view and in some experts' views (see Bostrom and Sandberg 2009, 311-341), if there are shortcuts to excellence, then access to those shortcuts is what determines success or failures, not one's inherent hard work. Moreover, some shortcuts in our society are completely acceptable. For example, performance enhancing athletic shoes and the use of calculators in high school physics promote authenticity. While we may be implicitly coerced into using calculators, I think it is acceptable because the use of a calculator allows us to focus our energies on the subject we are trying to master (whether it be using equations in Biochemistry or formulas in physics), rather than "wasting time" doing the algebra and not grasping the main idea of the science we are learning.

Another particularly intriguing question I was asked was "what are the cultural responses on enhancements?" Since I came at my paper from more of a neuroscience and ethics view, and less of a sociological or anthropological background, I didn't know much about the existing literature except to know that most cultures probably view it differently. For example, when speaking with my cousin my age in India, he does not know of peers with ADHD, has never heard of Ritalin, or even study drugs commonly used in US colleges, though he goes to a prestigious university in India. That got me wondering whether parents there immediately discredit those ideas and frown upon enhancements other than natural remedies. As a kid, I would always mix up my P's, F's and 5's and I had a hard time sitting on one place, so thought that maybe I needed to get tested for ADHD or maybe dyslexia. I remember when I voiced this thought to my parents, they immediately said nothing was wrong with me I just needed to focus better. As I mentioned in my paper, a study done by Ilina Singh on kids with ADHD in the

UK and the US underscores the idea that different cultures view enhancements differently (Singh 2014, 237-240). After asking children in both countries why they took Ritalin, the study found that kids in the UK mainly reported that they take Ritalin so they can "manage anger and bad behaviors" but kids in US reported that they take Ritalin to "be more productive and improve academic performance."

Another stimulating question a fellow speaker brought up stumped me at first. He asked whether glasses and clothes are considered enhancements. The answer to that lies in the definition. Though there are many definitions of cognitive enhancement, most say something among the lines of: "the use of drugs, biotechnological strategies or other means by healthy individuals aiming at the improvement of cognitive functions such as vigilance, concentration or memory without any medical need" (Hildt and Andreas et al 2013). So yes, while glasses can improve your ability to see what a professor is writing on the board, thereby allowing you to engage with the material more, they are not considered a form of enhancement, in my opinion, because they are not augmenting your cognitive ability [memory, reasoning, problem solving, etc.] as do the other enhancements.

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