

Deep Brain Stimulation: The Quest for Cognitive Enhancement

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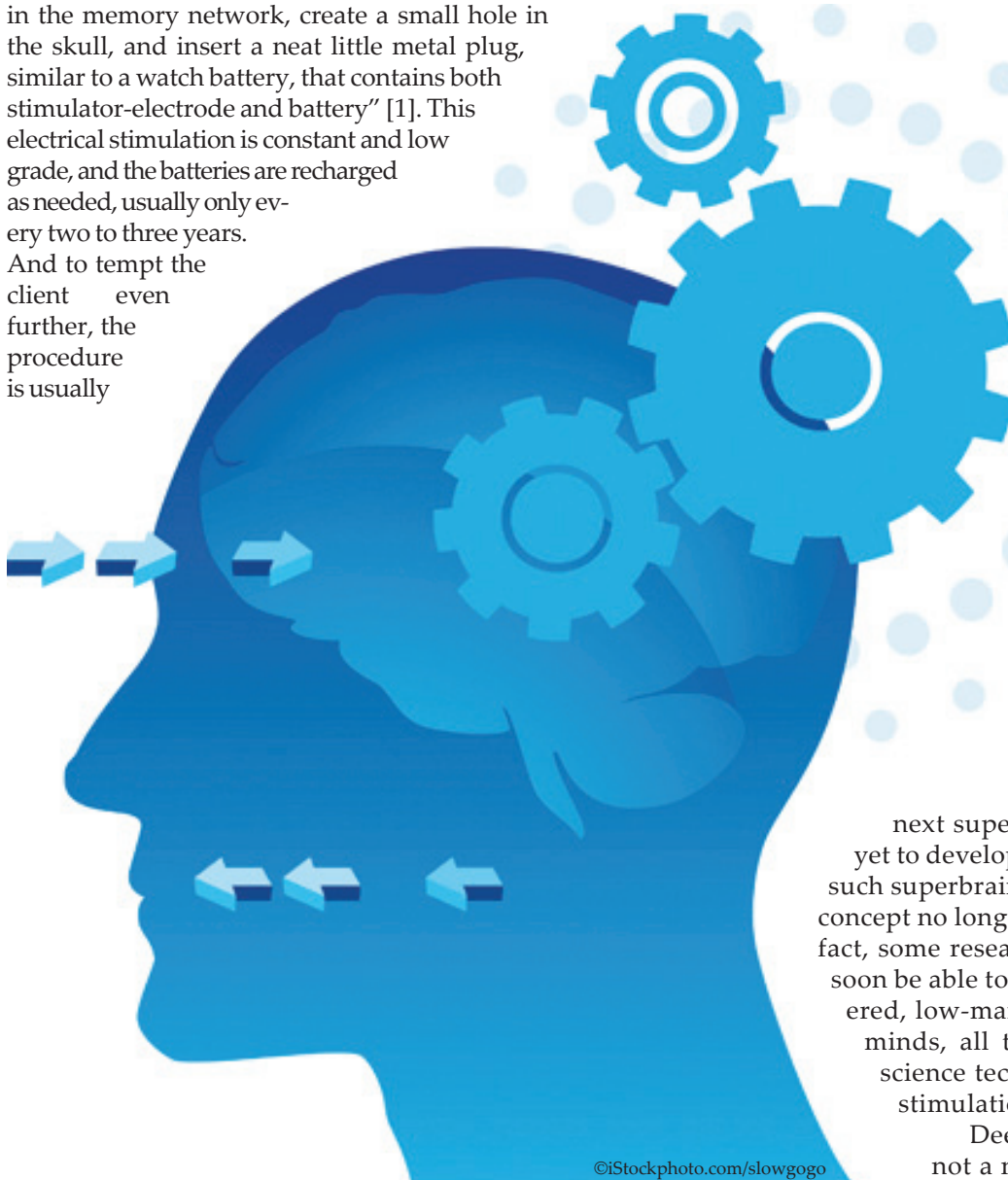
In his private practice located in the Upper East Side office of Manhattan, Dr. Lawrence Steele offers patients memory enhancement on a cash-only basis. His clientele, the wealthy elite looking for a “cognitive tune-up,” are presented with three options varying in levels of intensity and invasiveness. The first option is a memory training program that may take as long as weeks or months depending on how much time the patient is able to put in. The second consists of transcranial magnetic stimulation (TMS) treatments which can take up to half an hour for three times a week—time which is not wasted as the patient can obtain a manicure, pedicure, or massage while undergoing the treatment. The last option involves a more invasive form of electrical brain stimulation where the doctor will make “a small incision—half an inch—in the scalp overlying each major node in the memory network, create a small hole in the skull, and insert a neat little metal plug, similar to a watch battery, that contains both stimulator-electrode and battery” [1]. This electrical stimulation is constant and low grade, and the batteries are recharged as needed, usually only every two to three years. And to tempt the client even further, the procedure is usually

done on a Friday so that they can return back to work the following Monday.

It is this “brainlift” trend which triggers much of the ethical debate arising in academic world surrounding the use of cognitive science technologies for lifestyle memory enhancement. Yet Dr. Lawrence Steele remains confident in his belief that these techniques would become a more prevalent practice within society. “Plastic surgery triggered similar debates years ago, but the debates didn’t last. Brainlifts will go through the same cycle: they’ll gain broader acceptance, the debates will eventually die down, [and] the procedures will become more commonplace [. . .] After all, we’re talking about a more finely tuned mind, not just a tighter face” [1].

So imagine if you could enhance your brain, performing cognition faster than you have before and remembering more facts than you ever thought possible. Think about all the possibilities you could achieve by being smarter. For example, you could obtain the highest score on an entrance exam to gain acceptance to a dream university, and later, land the perfect job. If such possibilities entice you, to what lengths would you be willing to go to obtain the next superbrain? Although science has yet to develop the technologies for creating such superbrains, many people consider this concept no longer a science-fiction fantasy. In fact, some researchers speculate that we will soon be able to manufacture such high-powered, low-maintenance, memory enhanced minds, all through the use of cognitive science technologies such as deep brain stimulation.

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cal stimulation of the nervous system has been used for medical cases since the 18th century, ranging from attempts to reverse blindness to reviving drowned patients with electrical shocks [2]. A modern use of DBS has been for the treatment of Parkinson's disease, a degenerative disorder of the central nervous system which gradually impairs all motor skills and speech. When a patient develops side effects from the traditional L-Dopa medication,

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DBS entails implanting electrodes in the thalamus, which produce a high-frequency, low-voltage current that block the tremors symptomatic of Parkinson's disease. It is a last-resort method which shows significant improvement in 70-80% of the cases used [3].

More recently, some researchers have thought that DBS and similar methods of brain stimulation could be used to enhance people's memories. For example, in January of 2008 Canadian neurosurgeon, Dr. Andres Lozano, and his team at Toronto Western Hospital began investigating the effects of deep brain stimulation on a fifty year-old male with a history of obesity. They hoped that the electrodes implanted in the hypothalamus of the brain, a region recognized to control appetite urges, could repress the desire to eat and subsequently reduce the man's weight. However, what they discovered was a surprisingly different side effect—the patient recounted profound feelings of déjà vu; more specifically, he remembered a scene at the park with friends which occurred around thirty years ago. As the intensity of the electrical stimulation increased, the more details he could remember. Lozano proclaims, “This was for us a eureka moment in that we were not expecting it at all” [4].

This unexpected finding has led Dr. Lozano to believe that DBS may benefit patients suffering from Alzheimer's disease. In March of 2008, Dr. Lozano began a pilot study with six Alzheimer patients to research whether deep brain stimulation could delay the symptoms of the memory-degenerative disease that affects as many as 5.2 million people in the United States alone. Even if DBS would not be able to cure Alzheimer's, it is hypothesized to provide patients with a longer span of time in which they can function independently and normally—as long as they remain on the electrode system.

While the medical uses of DBS may be promising, if this technology was made available to the general public, the ethical, medical, social, and cultural implications of mind manipulation would be astounding. Advocates of deep brain stimulation emphasize the excellent targeting abilities and independent control qualities of the electrode system, since the electrodes could hypothetically be shut down and the effects nullified. Yet, as appealing as simply “turning off the electrode system” sounds, deep brain stimulation is not a completely reversible process. DBS would affect the patients' individuality as

they might become dependent on the electrode system for the rest of their lives. The procedure itself involves stereotactic surgery which entails structural modifications to the brain, running risks of intracranial hemorrhages, stroke, behavioral changes, and other factors associated with neurosurgery. And the chance of an electrode failure remains a significant risk. The perils to the brain are undeniable, and a person's motor performance, general mood, physical situation and overall quality of life would depend to a high degree on how well the technical device functions [5].

Thus, to address the growing awareness of cognitive science techniques such as DBS, an emerging discipline termed neuroethics has risen. First coined in the 1970's but not prominent until the early 21st century, neuroethics currently encompasses “professional ethics or procedural ethics regarding the conduct of neuroscience research; neurobiological basis of value systems, including moral and religious thought; and social implications of the outcomes of neuroscience research” [6]. As DBS becomes synonymous with brain enhancement, its advancement raises ethical issues for the neuroscience community—namely, where do we draw limits for its use? Axel Cleeremans, director of the cognitive science research unit at the Free University of Brussels, affirms “We are already performing the equivalent of plastic surgery on the brain [. . .] [but] do we really want cognitive enhancement via surgery or medication, and if so how do we regulate it? [. . .] How will we deal with issues such as privacy and responsibility?” [7]. As the field of neurocognitive enhancement becomes more popular among scientists, physicians, and marketable consumers alike, legislatures and the public will have to determine

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whether new regulations must be placed to control the lifestyle benefits of these new methodologies. Since DBS will be most likely limited through other factors such as cost barriers and availability, what would happen if DBS were to become accessible to the public as a memory enhancement technique, and how could that affect the already significant vast divide between those who are privileged, whether by social or economic status, and those who are not?

To learn more about the possible outcomes of DBS being made available to the public, we can draw from parallel issues concerning pharmacological treatments for improved cognition, which has already long been a focus for military research. The U.S. Air Force's use of amphetamines as “go pills” to treat fatigue of military personnel has been permitted as early as World War II [8]. Simultaneously, the use of prescription stimulants as cognitive enhancers have also been popular methods for people looking to sleep less, stay up longer, work harder, and play more [8]. In his book *Our Posthuman*

Future: Consequences of the Biotechnology Revolution, Francis Fukuyama vocalizes his standpoint in the brain enhancement debate stating, “The original purpose of medicine is to heal the sick, not turn healthy people into gods” [9]. He asserts that the use of neuropharmaceutical drugs such as Adderall, which is prescribed to treat attention deficit disorder, and Provigil, which promotes wakefulness for narcolepsy patients, already “raise the standard of what is considered ‘normal’ performance and widen the gap between those who have access to the

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medications and those who do not” [10]. Furthermore, brain enhancement could interfere with a person’s subjective experiences, cognitive abilities, and personality traits in unexpected ways. As Thomas Fuch mentions in his article “Ethical Issues in Neuroscience,” the use of cognitive science techniques threatens to devalue human life of its imperfections and interferes with the personal development that results from learning from failures and dealing with adversities [11]. After all, to what extent could people retain their individuality if their actions and thoughts were the result of deep brain stimulation? These techniques would further complicate the issues of identity and free-will, an already controversial topic that is still debated among various religious, philosophical, academic, political, and medical spheres.

Yet despite these concerns, experts have to admit that deep brain stimulation used for brain enhancement has its appeal. “It’s an interesting example of the sort of unexpected finding we may start to see as different brain areas are tested with DBS,” says Helen Mayberg, a neurologist at Emory University School of Medicine in Atlanta, Georgia. “It suggests that enhanced brain functioning—and not just reversal of abnormal behavior—is possible with DBS, and that’s going to prompt a lot of discussion among scientists and ethicists” [12].

But are these procedures really worth the extra memory? Neurosurgeon Katrina Firlirk vocalizes her opinion for the future of neurosurgery. Since surgical enhancement of the brain seems to be a viable option for the public in the near future, she speculates that the certain individuals looking for the “cognitive tune-up” would instead develop a savant-like mind. These elite savants will certainly “expand the potential for human

achievement and productivity beyond what is currently constrained by average human brainpower” [1]. Although they may have this newfound ability to “multiply 1,456 by 6,321 off the top of his head, or may be able to recite pi out to hundreds of digits,” it does not ensure that they can interact and communicate effectively with other human beings [1]. Thus, one has to doubt the human desire to obtain an unlimited memory. Joshua Foer, in his article “Memory” for National Geographic, discussed the rare case of a person with extreme memory function: a 41-year-old woman named AJ who remembers every single day of her life since she was 11, an ability so unprecedented that neuroscientists at University of California, Irvine, had to coin a new term to describe her condition: hyperthymestic syndrome [13]. However, AJ’s quality of life is actually impaired by her superior memory. Although she can flip through each day of her life like a Rolodex and remember every moment as if it was yesterday, she remains eternally obsessed about the past:

I remember good, which is very comforting. But I also remember bad — and every bad choice [. . .] I really don’t give myself a break. There are all these forks in the road, moments you have to make a choice, and then it’s ten years later, and I’m still beating myself up over them. I don’t forgive myself for a lot of things. Your memory is the way it is to protect you. I feel like it just hasn’t protected me. I would love just for five minutes to be a simple person and not have all this stuff in my head. Most people have called what I have a gift, but I call it a burden [13].

Indeed, AJ may have a point. There are evolutionary explanations as to why we forget things; after all, if we could remember every single facet—everything we saw, smelled, tasted, felt, heard, or thought—we would be overwhelmed by a vast amount of irrelevant information not directly related to our current situation in life. So as DBS ventures into the realms of treatment for Alzheimer patients, I applaud that move and hope for the best. But if given the option of a superbrain? I may have to pass. I don’t need to remember what I wore a year ago, or how I just disastrously failed yesterday’s midterm. Those are memories I’d rather not keep, thanks.

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