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Jennifer Dang

Neuroenhancement: Is Society Ready?

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A capstone submitted in partial fulfillment of the requirements for the degree Master of
Science in Biomedical Sciences – Neurobehavioral Concentration

Abstract

Humans were always able to discover and invent solutions to our species limitations, from the discovery of vaccines and irradiation of diseases to the invention of personal computers that could fit in our pockets. Concerning the idea of scientific and technological advancements, it is never the question of whether or not scientists could discover these achievements, but it is always the question of whether or not science should create or discover something. In regards to the topic of neuroenhancement, experts have been unable to unanimously determine if, as a society, we are morally responsible enough to handle such an advancement. Neuroenhancement is the use of pharmaceuticals and/or technologies to improve the cognitive abilities of a healthy individual. There is already an expressed interest from society to using neuroenhancements, as many individuals use pharmaceuticals such as Modafinil, methylphenidate, and Adderall off-label, with many of these pharmaceuticals purchased illegally, to potentially boost their cognitive capabilities. Even with the growing interest in society, experts are concerned with the potential concerns of introducing neuroenhancement into society. Three of the biggest concerns surrounding cognitive enhancements are safety, risk of coercion, and distribution justice. In regards to safety, many individuals are uncomfortable with disturbing healthy brains for the potential of enhancing it because of the possible adverse side effects from electing to partake in an “unnecessary improvement.” Regarding the risk of coercion, if neuroenhancements were to be available to the public, individuals may feel compelled to artificially enhance themselves to be competitive in their careers or society. This takes out the desire to improve oneself

for self-actualization, but rather to improve oneself to be part of a community. Regarding distribution justice, society already has an issue distributing currently existing items fairly. To introduce a product that may cause more inequality will only hinder society. Neuroenhancement may not just refer to cognitive enhancement, but potentially someday, may lead to manipulation of moral behavior. Currently, society is not ready for the responsibility of neuroenhancement, and society might never be ready.

Introduction

Scientists have rigorously strived to find answers and solutions to our human problems and issues. As a species, we were able to identify various diseases, explain the functions of our organ systems, and examine the different cells that make up those systems. From this, we were able to generate antidotes and medications to treat various illnesses and even eradicate several diseases. As our understanding of science (specifically our bodies) develops, our findings and discoveries become more impactful and advanced. However, as we begin to explore our new findings, scientists should be cognizant of our limitations as a species, not only the limitations to what we can understand and achieve, but also the limitations of our human psychology and societal motivations. In Jurassic Park, Jeff Goldblum's character mentions that the scientists in the fictitious world who helped genetically engineer the dinosaurs were "so preoccupied with whether they could, they didn't stop to think if they should." Genetically engineered dinosaurs may be science fiction; however, his character's statement is applicable to many of today's scientific and medical advancements. As science continues to advance to the point where humans may have the capacity to manipulate ourselves and nature, we must continuously remind ourselves of the potential ethical dilemmas that may materialize with such unlimited advancements.

Bioethics is a subject field that focuses on the ethical issues that emerge from the advancements in biology and medicine. These ethical issues range from debates over the boundaries of life (i.e. abortion) to a patient's right to refuse medical care. Science and research have greatly advanced to a scope where new biotechnologies may be utilized for

manipulation of biology through altering DNA, such as in the realm of cloning and gene therapy. Many have predicted that “the twenty-first century will be the century of neuroscience” and that “(h)umanity’s ability to alter its own brain function might well shape history” (Farah et al., 2004). With such anticipation for the advancements in neuroscience, a newer branch of bioethics focusing on neuroscience has emerged. Not only are scientists interested in manipulating and improving human brains, but further knowledge of the brain’s connective layout may evolve into the potential development of artificial intelligence. Some will argue that “virtually all bioethical issues concerning any organ system or medical specialty have counterparts involving the brain, neurology, and psychiatry” (Farah et al., 2004). Regardless of some overlap, experts and scholars in the field of bioethics realized that advancements in neuroscience will give us unprecedented knowledge to understand the brain and mind to possibly be able to control and influence it, leading to ethical issues that focus less on biology and more on the philosophy of mind, psychology and neuroscience itself. These new ethical issues give rise to the field of neuroethics.

Neuroethics is a young, emerging field that concerns the implications of increased understanding of neuroscience and our ability to influence our brain (Leefmann et al., 2016). One of the most highly debated topics in the realm of neuroethics is neuroenhancement. Traditionally, the goal of medicine was to treat illnesses with the assistance of drug compounds and surgical procedures. Neuroenhancement is the utilization of neural technologies to improve an unimpaired and healthy individual’s neurological brain functions. With an increase in understanding of the drugs’ role in the

body, researchers have been experimenting with the possibility of enhancing normal cognitive functioning via pharmaceuticals. However, neuroenhancement is not limited to only pharmaceutical advancements. Advancements in newer neurotechnology, such as transcranial electrical brain stimulation and deep brain stimulation, are currently helping those with serious neurological conditions from brain injuries to Parkinson's disease. With continued research into these new technologies, scientists may begin to experiment with implantations into healthy adult brains.

Neuroenhancement has been a controversial topic in the medical community, with questions of the limitations that humans will encounter when working with the brain to ethical questions of whether we should even try to manipulate parts of the brain. Neuroenhancement generally involves the use of neurotechnology in individuals "to improve cognitive, affective or behavioral functioning, where these are not judged to be clinically impaired" (Bard et al., 2018). Generally, when the public hears about the topic of neuroenhancement, they think primarily of the enhancement of an individual's cognitive function. Currently, a large focus of ethical discussions on neuroenhancements involve the use of off-label pharmaceuticals for cognitive performance enhancements, such as drugs that were originally for the treatment of attention deficit hyperactivity disorder (ADHD) (methylphenidate), narcolepsy (modafinil), and Alzheimer's disease (memantine). The public's understanding and interest of the what could be "enhanced" in an individual's brain stops at cognitive performance, as demonstrated by mainstream media/movies (*Limitless*) and what those who are seeking to misuse pharmaceuticals for (improved performance in concentration and focus). However, as mentioned in 2019's

issue of the *Neuroethics* journal, the public should not only be concerned with only cognitive enhancements, but also with the possibility and potential dilemmas of moral enhancements.

Cognitive Enhancement

There have been surveys conducted that show students from various backgrounds and professionals such as surgeons have used substances off-label to improve on their cognitive performances (Schelle et al., 2014). Surveys and studies have shown that about 6.9% to 35.3% of the student populations from different countries, studies, and backgrounds have admitted to misusing prescription stimulants such as methylphenidate (Ritalin) (Forlini & Racine, 2009). There have been recent issues concerning the ethical dilemma of doping using neurocognitive enhancers during cognitively demanding activities, such as a competitive chess match or taking an exam. Due to the declining ability to encode new memories as one ages (Craik and Salthouse, 1992), many older adults are very interested in the advancement of memory enhancements. With a wide profile of individuals and groups interested in utilizing pharmaceuticals to provide them with an edge in academics, competition, and career, many scholars have been increasingly interested in the ethical issues that are involved with the augmentation of brain functions via pharmacological cognitive enhancements (PCE).

According to several studies, the most commonly used pharmaceuticals for off-label cognitive improvements/enhancements are modafinil (Provigil), methylphenidate (Ritalin), and Adderall. Modafinil/Provigil has gained popularity in usage after the release of the 2011 science fiction thriller film *Limitless*. Starring Bradley

Cooper, the film focused on the increased potential that the main character gains in his life after being introduced to a fictional neuroenhancing drug. After the film's release, many young adults began seeking out the "real life" equivalent of the film's drug, stumbling across Modafinil. A quick search on Google's search engine for "modafinil results" will lead those curious to numerous websites, blogs, and videos dedicated to the usage of the "real life *Limitless* drug." One author wrote an article for the Medium on his experience with experimenting with Modafinil. He explains to a curious online audience what Modafinil was created for, his initial concerns with using the drug off-label, his experiences with using the drug, and even mentions ways of procuring Modafinil online. A detailed account of the effects the author immediately experienced also provided his personal reasoning and desires for using Modafinil off-label. Wanting to "test his brain" and provide a boost in his day-to-day productivity, the author did research into Modafinil before purchasing a supply, where after a trial period he felt Modafinil lived up to its internet claims and fame (Falsner, 2016). Modafinil is not the only drug used by the young adult population to increase their cognitive production. From personal witness accounts, several college students have been seen purchasing Ritalin and Adderall on college campuses from students with prescriptions to help them "stay productive" during long study sessions. This has been confirmed with studies that showed 20% of academic students have experimented with off-label use of methylphenidate and modafinil to attempt to improve their cognitive performances (Greely, et al., 2012).

Many healthcare professionals, public health experts, and ethicists have tried to gather information to understand why the general population may have preconceived

feelings about potentially utilizing any form of neuroenhancement, pharmaceutical based and non-pharmaceutical based enhancements, for healthy individuals in society. With the increased prescription of methylphenidate (Ritalin) to help treat ADHD in recent years, the population has an easier access to procure the stimulant for “off-label” use. Also, data has shown that adults are interested in purchasing nutritional supplements to improve their memory, whether from supplements that can be purchased in stores like Target and Walgreens to “unregulated” supplements purchased internationally on the internet. One can type in “best nutritional supplements for memory” into any search engine and have many mainstream websites recommend their “Top 10 picks” for memory supplements. However, with this level of interest from the population, professionals and experts must be diligent to address the possible effects on an individual’s health and safety, along with addressing the potential inequalities that may arise from the desire for excellence. In Farah et al’s article “Neurocognitive Enhancement: What Can We Do and What Should We Do?,” the authors briefly explained the various problems and concerns to consider when addressing pharmaceutical neuroenhancements. The concerns of safety, coercion by an individual’s employment and society overall, and distribution justice were addressed. However, the authors’ main objective was to state that the interests in neuroenhancements will not disappear, with the agreement that policies must be enacted early in the life of neuroenhancements to help prevent safety issues and prevent injustices (Farah et al., 2004).

Concerns of Safety, Coercion, and Distribution Justice

In Kimberly Schelle's review of the attitudes towards pharmacological cognitive enhancements, she further elaborated on the questions and concerns that were brought up by Farah. According to Schelle's review, three of the most common concerns surrounding PCE were medical safety, coercion, and fairness, identical to the concerns mentioned by Farah. Concerns surrounding the medical safety of PCE primarily focused on the potential trade-offs between the benefits these pharmaceutical products can provide and the risks of using PCE can cause to a cognitively healthy individual. However, this should not be the only focus regarding the medical safety of PCE, as the potential for mental health problems such as addiction could outweigh any perceived enhancement in cognitive performance. It has been noted in Bard's *Bottom's Up Ethics* (2018) that if a particular pharmacological cognitive enhancement drug has a higher efficacy level, and the user has a lower level of base performance, many are more willing to support the use of a cognitive enhancer. This has also been addressed in Farah et al.'s review, that "our tolerance for risk is smallest when treatment is purely elective" (Farah et al., 2004). Comparisons of PCE were made to cosmetic surgery, where in both situations, individuals are looking to improve themselves via external factors. However, because the brain and nervous system are less known and complex, many are more hesitant to engage in PCE because of the unforeseen risks associated with solutions such as the "misuse" of pharmaceutical stimulants (Ritalin).

This can be tied to another common concern surrounding pharmacological cognitive enhancements, that the concern of coercion to use a PCE must be addressed prior to the acceptance of PCE into everyday life. "The question of coercion relates to

autonomy, i.e. the freedom to decide about one's personal life" (Schelle et al., 2014), and this is the main issue concerning the debate on coercion to use pharmacological cognitive enhancements. Coercion could be as simple (and indirect) as a form of peer pressure from observing society's growing acceptance of utilizing PCE or as direct as pressure from an individual's workplace to keep up with a growing demand for cognitive output. Whatever the coercion may be, a person's autonomy is threatened when their choice to improve themselves is being influenced by an external factor. It has been shown in studies that portions of the general population agree with the idea that humankind should strive to advance and improve as a species (Bard et al., 2018). However, studies also elaborated that the use of PCE should be a choice for an individual, not a requirement for a career. If the ethical dilemma of coercion is left undiscussed, and laws are not in place to protect one's choices, an individual may be forced to partake in the use of pharmacological cognitive enhancements just to be viable in their careers, whether they want to or not.

The fears of a "forced coercion" via society or workplace to improve via any means are affecting this current generation. For instance, in the Chinese competitive video game scene, players have been known to use various cheating software, indulging in beverages with high caffeine levels, and dabbling in pharmaceuticals that keep their attention up with minimal sleep, just to get their name on the leaderboard of the game (Lee, 2018). In societies that are highly competitive, factors such as PCEs may promote many in the community to engage in their use out of fear of falling behind others. This may persuade individuals who desired to participate in safe means of self-improvement to feel pressured to keep up with their peers through unsafe and unregulated channels. In

regards to the Chinese video game culture, instead of putting in hours of practice honing mechanical skills for the game to earn top rankings, they could simply invest in software to get them there. The willingness to take drastic lengths to improve in an individual's hobbies illustrates the potential threat to one's autonomy to choose to improve oneself in one's career, where their financial security may be in jeopardy. If our current society is willing to take uncertain risks to get ahead in a hobby, what will our society risk to rise up in their careers?

The broadest concern of pharmacological cognitive enhancements is the concern of fairness and distribution justice. The category of fairness can be further divided into three subcategories: equality of opportunity, honesty, and authenticity (Schelle et al., 2014). Equality of opportunity is a familiar topic in education and medicine. For instance, students from more economically privileged families and towns are provided with more abundant and better resources to prepare for standardized tests and applying to colleges compared to a student from a disadvantaged background. Also, in relation to medicine, those from more socioeconomically privileged area are able to access better quality of care due to variables like close proximity to good healthcare providers or their insurance plans allowing customers with better options and choices. Many debates have been centered around this concern of equality of opportunity, and the mainstream introduction of PCE with further complicate the discussion. To elaborate on the concerns of equality of opportunity regarding PCE, the topic of education can illustrate the concerns. A student from a socioeconomically disadvantaged background, like a student in a rural area without the funds to obtain PCE, may not perform as well as a student who is able to

utilize PCE. This level of inequality will have a ripple effect throughout their lives, as the already privileged student will have an easier time advancing in academics and in their careers compared to their disadvantaged counterpart. To ensure equal opportunity in nearly every sector of society has created many debates that illustrate the difficulties of understanding equality and how to create laws and regulations to help those who were given a difficult starting hand without negatively affecting those who started off more privileged. Introducing an innovation like pharmaceutical cognitive enhancement (PCE) will more than likely cause additional inequalities for society to overcome.

The concerns of honesty with the use of pharmacological cognitive enhancements have already been felt in our current society. Similar to the concerns of doping in physical sporting events, cognitive doping in activities such as chess have become a large concern for the integrity of the competition (Mihailov, 2018). Honesty is not only limited to competition, as honesty in educational and workplace settings are important to address. Several studies have been conducted to quantify the groups and individuals who have used PCE in an educational or workplace setting and their thoughts on the fairness of the practice. In general, half of the population who partook in the study believe the use of PCE provided the user with an unfair advantage (Bard, et al., 2018).

Societal View and Portrayal of Cognitive Enhancements

An unforeseen problem that is currently affecting the potential rise in “misuse” of pharmaceutical cognitive enhancements (PCE) such as methylphenidate is how the media may be portraying neurocognitive enhancement. According to the study by Cynthia Forlini and Eric Racine, the print and mainstream media tend to use more positive

nomenclature to describe PCEs. They have been shown to use words such as “study aid,” “smart drug,” and “brain steroids” when describing the “misuse” of methylphenidate (Ritalin). The authors believe print media tend to shy away from using more formal terms, such as “cognitive enhancement,” which is more likely to be used in articles and media for bioethics experts. It was also determined that the “framework” and nomenclature that describes the misuse of methylphenidate depends on who is presenting the information. Generally, print media tend to depict the misuse of methylphenidate as a “lifestyle choice,” that some are using pharmaceuticals for self-improvement (Forlini & Racine, 2009). Print media also tend to avoid discussing the risks of methylphenidate misuse. It has also been shown that media articles tend to claim that the misuse of methylphenidate and other PCEs are very common in society, especially in an academic setting. However, academic literature does not fully agree on the “significant rise” as demonstrated by print and news media (Partridge et al., 2011). In contrast to print and news media, those in public health tend to describe neuropharmaceuticals in a more negative light, using nomenclature such as “prescription drug abuse.” Subsequently, those in the bioethics sector describe PCE for what they are, “cognitive enhancement.” However, those in bioethics are very concerned with the ethical issues behind more widespread PCE usage, which those in public health are concerned primarily with public safety (Forlini & Racine, 2009).

Print and news media have a large impact on how a population perceives a problem. Some may believe that this “rise” in PCE may mean enhancing is more common place, thus individuals may be tempted to experiment themselves, especially

when the media does not fully illuminate the risks that are involved with methylphenidate and other pharmaceutical misuse. Experts have not conducted the appropriate amount of studies on the enhancement effects (positive and negative) on healthy individuals to determine not only if there are significant enhancements with use, but also whether the potential risks are worth any of the gains (Forlini & Racine, 2009). There have been studies that have shown the viewpoints of students and their usage of PCE. In a study of Swiss University students, about 13.8% of students have admitted to misusing pharmaceuticals and alcohol specifically for the potential neuroenhancement. The rates were higher for those students in the later years of their study, and uses were more predominant/frequent in instances leading up to important exams or papers (Maier et al., 2013). Another study based on the propensity to use PCEs in Italian medical studies suggests that the majority of the students who participated in the study (74.7%) claimed to use a PCE to improve their cognitive function. The Italian medical students also expressed in the survey concerns over the safety of using PCE (83.3% of participants) that prevents them from using the drugs, however, many of the students (60.3% of participants) had a positive attitude towards the idea of enhancing their cognitive abilities (Pighi et al., 2018). These results may illustrate the effects that the media may play on public perception and use of PCEs. Although very little students used PCEs daily, potentially due to the uncertainty of the safety of PCE use on healthy individuals, the media may have swayed the decision for students to try PCEs in an attempt to get an edge in the “competitive” aspect of their studies. For many of these students, it was not the desire for self-improvement that was their motivation for using a PCE, but it was the

potential for giving them the edge over the competition that may have encourage taking the unknowing risks of using PCEs.

Potential Use of Neuroenhancement

Generally, when someone typically mentions neuroenhancement, they are referring to cognitive neuroenhancement. Cognitive enhancement is the use of technologies, pharmaceuticals, and/or any other substances with the intent to improve a cognitively healthy individual's executive functions, memory, and creativity (Dubljević, et al., 2015). It is reasonable for the public to only be able to envision science innovations being able to manipulate an individual's cognitive capabilities. However, if science were able to discover adequate forms of cognitive enhancements, what would prevent scientists from eventually discovering methods to manipulate other parts of our brain, like our reliance on sleep, sense of reality, or morality.

For the time being, science is still uncertain how the connections in our brains work during cognitive functioning. But like all scientific and technological advancements, scientists may someday be able to rectify our human limitations of procrastination and diminishing memory as we age. Whenever the time comes, if it ever does, we must be cognizant of the potential harm that will come from our growing understanding of our brains. Experts in neuroethics have not only focused their attention on the relatively close reality of cognitive neuroenhancement, but also on the potential of moral neuroenhancement, manipulation of what makes us human, and use of these in society (such as assistance and manipulation in the justice system) (Perrson & Savulescu, 2017). As demonstrated in the survey conducted by Bard et al., many agree that it is

human nature for an individual to want to improve oneself and see their species make strides in their evolution. Some experts have viewed that our society should not attempt to dissuade the eventual determination to improve our minds, through natural or artificial means, and that we would be preventing our species' next evolutionary phase if we do not encourage scientists to look into neuroenhancements.

However, what would be the implications of pursuing neuroenhancements past our society's current desire for cognitive enhancement? The focus of *Neuroethics* 2019 issue is the potential and ramifications of moral enhancements. Some philosophers and ethicists have expressed great interest in the topic of moral enhancement, that it could lead to the prevention of crime, assist those with questionable moral compasses, and potentially lead a society into a better world. Norbert Paulo mentions that "education, moral, legal, or religious systems... are examples of traditional ways of influencing moral behavior for the better" (Paulo & Bublitz, 2018). Those who resonate with Paulo's words may believe that societies have tried to manipulate their citizen's morals with implementation of laws and regulations. They may argue that if we are comfortable forcing others to adhere to rules and laws set in place by governments and person-run organizations, that would the potential use of neuroenhancement and neuro-manipulation be just the next step in ensuring an individual's morals are similar and complimentary to society's?

Consequently, in keeping with the same thought process of legal and religious systems influence moral behavior for the better, what is preventing someone with negative intentions from abusing a system's influence on their society's moral behavior.

For instance, religious and government systems are run by (typically) elected officials who represent their constituents to determine the laws that will encourage their community's moral behaviors. Throughout history, that are a variety of examples where those in power will attempt to use that power for their own self-interest rather than for the interest of their constituents. The implementations of laws by a governing body still allows for individuals to choose whether they agree with such laws and moral behavior or not. However, if those who view moral neuroenhancements along the same line as governing systems agree that it would provide moral structure for a society similar to those systems, individuals will lose their autonomy to choose whether or not they agree with their society's moral behavior.

A more direct use of enhancing and manipulating an individual's moral behavior would be within the justice system. Some experts illustrate the potential positive possibilities with utilizing science innovations of neuroenhancements to help determine innocence or guilt. However, similar to the issues of lost autonomy when implemented in the grander scale of communal moral behavior, those entangled with the law may have their rights and autonomy interfered with in the name of the greater good. What benefit would moral enhancement provide if it were in the hands of an individual who had questionable motivations.

Is Society Ready?

Experts on the subject of neuroenhancement have not unanimously agreed on whether we should even attempt to investigate the potential of neuroenhancements. There are countless examples of our society being unable to morally measure up to handle

controversial scientific and technological advancements. For instance, the technological innovation of editing videos, when put in the hands of a malicious individual, would produce fictional videos with the intention to scare or manipulate others to the malicious individual's benefit. Currently, as a society, we are not ready for the responsibility that would come from an advancement as fascinating and dangerous as neuroenhancement. We are currently unable to responsibly manage carbon emissions and overproduction of products without negatively impacting our environment. If scientists were able to discover a pharmaceutical that may alter an individual's cognitive or moral state and allowed for public consumption, we are not morally equipped to handle that responsibility. However, experts have raised the possibility of our species ever being ready to benefit from neuroenhancements.

Before science continues to observe the effects of pharmacological cognitive enhancements on the brain and experiment with new products, experts should pause and take into consideration the ethical dilemmas that will be introduced into the society if such products become readily available to the public. The benefits of enhanced cognitive functioning amongst a population currently does not outweigh the risk of safety, nor does it outweigh the concerns of equality of opportunity and issues with autonomy of using pharmacological cognitive enhancements. Many have expressed the importance of self-improvement and finding the means to improve oneself as a very human characteristic. Only after discussing and deliberating on these neuroethical issues should science researchers be able to step into this domain of neuroscience. The question of our

society ever being ready to fairly and morally implement the use of neuroenhancement may never be unanimously concluded.

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