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Deep Brain Stimulation and the Ethics of Preventative Medicine

In this paper I use the example Deep Brain Stimulation (DBS), a relatively new form of neurosurgery, to investigate the ethical status of medical enhancement. I conclude that examining DBS bolsters the conclusion that at least some enhancements are ethically acceptable, specifically those enhancements focused on the prevention of disease. I begin by providing an overview of the bioethical debate concerning medical enhancement, and then I recreate Juengst's (1997) argument for considering medical enhancement for disease prevention as ethically acceptable in the context of genetic medicine. I continue by summarizing the technological and ethical contexts relevant to DBS, and I conclude by analyzing the medical enhancement debate in the context of DBS. In the end, I find that prevention-focused medical enhancement through DBS offers a promising opportunity to greatly improve patient outcomes without treading into ethically questionable territory. Nevertheless, DBS brings with it a host of potentially problematic ethical baggage. The future of DBS in preventative medicine is bright, but technological and medical progress must be tempered by a constant recognition of the potential consequences of ethical missteps.

I.

Juengst (1997) questions whether enhancement can be distinguished from prevention in genetic medicine. I will relate his arguments in detail, critique his reasoning, and adapt an altered argument for application in the context of preventative medicine and deep brain stimulation.

Juengst investigates whether or not a line can be drawn between enhancement for prevention (like the polio vaccine) and what might be considered illegitimate enhancement (genetic manipulation to make a human exceptionally fast, strong, smart, etc.). In the end he concludes that such a line *can* be drawn, if we are willing to accept two somewhat “old fashioned” claims:

1. Some health problems are best understood as if they were entities in their own right, reifiable as processes or parts in a biological system, with at least as much ontological objectivity and theoretical significance as the functions that they inhibit.

2. Legitimate preventive genetic health care should be limited to efforts to defend people from attack by these more robust pathological entities, rather than changing their bodies to evade social injustices.

I aim to defend a distinction between legitimate and illegitimate enhancement without accepting either of these two claims. As such, I will argue that the acceptance of neither of these claims is essential to distinguishing between legitimate (preventative) enhancement and illegitimate enhancement in the context of either genetic or neurological medicine. Before we get there, let’s look back at Juengst’s arguments.

The issue Juengst tackles begins with the **therapy/enhancement distinction**, which regards as distinct (i) genetic manipulation to treat existing health problems and (ii) genetic manipulation to enhance or improve normal human traits. Many argue that the first kind — therapeutic genetic interventions — are ethically acceptable applications of genetic medicine and fall within the proper domain of medical practice. On the other hand, the second type — genetic manipulation to enhance normal human traits — are different, ethically. There is a good deal of support for this therapy/enhancement distinction, and some conclude further that so-called *medical therapy* is ethically permissible, while *enhancement* is problematic.

One line of argument toward the unacceptability of *enhancement* is that such interventions do not fall within the proper domain of medical practice. Medicine's proper domain of practice, one might think, does not include the enhancement of normal human traits, and so genetic therapy with the purpose of, for instance, making a normal human smarter, happier, faster, stronger, etc. is ethically unacceptable.¹ This is an understanding of the therapy/enhancement distinction with normative force; it entails that enhancements are illegitimate applications of medicine while therapies are legitimate applications of medicine.

There are several ways to criticize this therapy/enhancement distinction. Juengst acknowledges a few,² but he focuses on one in particular that highlights the fuzzy line

¹ Juengst 1997.

² Juengst (1997):

(i) "medicine has no essential domain of practice", and so there is no ethical distinction between therapy and enhancement;

(ii) there is an essential domain of medical practice including therapy and excluding enhancement, but this is wrong because "privileging treatment over enhancement is itself wrong"; or

between illegitimate enhancement and enhancement used to prevent future maladies (for instance, vaccination from the poliovirus). This critical response could go something like this: the therapy enhancement-distinction dissolves when we consider the case of genetic engineering for the prevention of disease, specifically through enhancing the body's health maintenance capacities. Because disease prevention is an accepted practice and well within the proper domain of medicine, it is evident that genetic engineering for enhancement does fall within the domain of medicine when it is done for the sake of disease prevention.

Enhancement is essential to prevention-focused genetic manipulation, so how can it be that enhancement falls outside of the proper domain of medical practice? It does not seem that it could, and so critics conclude that the "treatment/enhancement distinction cannot confine or define the limits of the properly medical use of gene transfer techniques".³

Because prevention-focused genetic medicine provides clear examples of medically acceptable enhancement, it is incorrect to state that enhancement falls outside of the proper domain of medicine. On the contrary, prevention-focused enhancements are clearly acceptable applications of medical practice. So, unless prevention-focused enhancements can be reliably distinguished from illegitimate enhancements, then it is incorrect to call enhancements illegitimate. Without a clear line drawn between prevention-focused and illegitimate enhancements, the therapy/enhancement distinction breaks down.

Juengst, however, believes that this **prevention/enhancement distinction** *can* be defended, at least in the context of genetic medicine. To be a bit more specific, Juengst

(iii) psychological and economic reasons make it the case that "the line between treatment and enhancement will be impossible to hold in practice."

³ Juengst (1997) p. 126.

argues that a line can be drawn between preventative therapies and illegitimate enhancement, and this line can be drawn such that the preventative enhancements can be considered to be within the proper domain of medical practice (and are therefore ethically acceptable), while illegitimate enhancements are not within the proper domain of medical practice (and so are ethically unacceptable). So, I turn now to examining Juengst's arguments toward a distinction between prevention-focused enhancement and illegitimate enhancement.

Central to his reasoning is how the proper domain of medical practice is defined. So, just what is the proper domain of medical practice? Entwined with this question are a few more questions. First, what are the appropriate ends of medicine? That is, just what should healthcare practitioners be trying to accomplish? In answering this, we might wonder: what are legitimate healthcare needs, and what are the limits of legitimate healthcare needs?

Juengst focuses on the Normal Function account to answer these questions. The Normal Functionalist holds that the appropriate end of medicine is health or the treatment of disease. Legitimate healthcare needs, then, are constituted by disease or deviations from health. We might define **health** as functioning "under typical circumstances, with the typical efficiency of members of one's age, gender and species", while **disease** is "characterized by a fall from that level of functional readiness." And so "proper healthcare services, therefore, should be aimed at getting people back to 'normal', e.g., restoring an individual's functional capability to the species-typical range for their reference class, and within that range to (the bottom of) the particular capability level which was the patient's

genetic birthright.”⁴ The proper domain of medical practice is wholly constituted by attending to legitimate healthcare needs through working toward the only appropriate end of medicine (synonymously): health, freedom from disease, or **normal functioning**.

So, on the Normal Function account, medical enhancement ☐ genetically augmenting cognitive ability in a normally functioning individual, for instance ☐ is not within the proper domain of medicine. Such an intervention does not attend to a legitimate healthcare need, and so is ethically unacceptable.

A first question to consider is whether we should endorse the Normal Function account of medicine. Juengst states that an “advantage of the Normal Function account is that it provides one relatively unified goal for healthcare, towards which the burdens and benefits of various interventions can be relatively objectively titrated, balanced, and integrated.” One way to make a judgment about the desirability of the Normal Function account of medicine is to examine its strongest alternative: a Positive Health account of medicine.

A Positive Health account of medicine regards the purpose of medicine to achieve a level of functioning properly described as *flourishing*. Rather than achieving a level of functioning *within* a species-typical range, a positive health account of medicine seeks a level of functioning *at the top* of species-typical functioning. However, Juengst⁵ points out that “the trouble with calling physical or mental or moral excellence health is that it tends to unite under one term a value neutral notion ☐ freedom from disease ☐ with the most controversial of all prescriptions: the recipe for an ideal human being.” By making ideal

⁴ Juengst 1997.

⁵ Juengst 1997.

health the principle end of medicine, then various issues are introduced because it renders us all inevitably unsuccessful examples of medical intervention; none among us are of genuinely ideal health.

This account entails a couple of issues. First, it establishes all manner of problematic enhancements as acceptable healthcare interventions. An example of such an intervention would be an extensive and unnecessary cosmetic intervention. Another issue is that the account is epistemically problematic: it is impossible to know what the ceiling of human functioning is – how far is too far? We cannot know. In light of these challenges, the Normal Function account appears to me a more defensible default perspective on the appropriate ends of medicine.

Enhancement for Prevention of Disease and Illegitimate Enhancement

An essential question remains: can the Normal Functionalist draw a line between legitimate enhancement (enhancement for the prevention of disease) and illegitimate enhancement? It is typically accepted that disease prevention falls well within the proper domain of medical practice, so the polio vaccine is an example of a medical intervention that should certainly be considered ethically acceptable on any good account of medicine. The polio vaccine works by enhancing the body's normal health maintenance capabilities. It is not an intervention which cures some disease, but rather prevents a disease by enhancing the body.

Juengst formulates a possible summation of the Normal Functionalist position with respect to preventative medicine as the following:

The central purpose of preventative health care is to maintain the range of opportunity and functional efficiency threatened by disease and disability. Successful preventative health care preserves for people the range of capabilities they have in the absence of pathological conditions, or prevents further deterioration.⁶

Many preventative measures would clearly be acceptable under this understanding; namely, all non-enhancing preventative health interventions clearly satisfy the criteria listed above. One example is supplying individuals with hypocholesterolemia with the low-density lipoprotein receptors they lack.⁷ The question remains, however, whether enhancement-based preventative interventions (like polio vaccination) would be ethically acceptable on the Normal Function account.

Juengst believes the Normal Function account cannot justify enhancement-based, preventative health interventions. This is because “susceptibility to infection by the polio virus is not a deviation from normal species typical functioning.” The Normal Function account only recognizes as legitimate health needs deviations from normal species typical functioning, and so it is not immediately clear that administering a polio vaccination would fall within the domain of proper medical practice on the Normal Function account.

However, given the central purpose of preventative healthcare stated above, I see little reason why an enhancement would not be allowed in order to achieve the goals of preventing deterioration in functioning and preserving a patient’s range of capabilities.

⁶ Juengst 1997, p. 132.

⁷ Juengst 1997, p. 132.

Juengst comments further that the Normal Functionalist cannot reliably distinguish between illegitimate enhancements and enhancements for disease prevention. He sums up his view of the Normal Functionalist position:

the Normal Function account is here faced with the same kind of limitation that 'positive health accounts' faced in trying to distinguish legitimate treatment from improper enhancements: it can posit a line between prevention and treatment, but it cannot indicate, on its own, when that line is being crossed... **the Normal Function account seems blind to the difference between strengthening the body to resist disease and strengthening the body to gain other advantages.**

The issue with Juengst's statement is that the Normal Function account *could* indicate on its own when the line between enhancement and prevention is being crossed. Namely, that line is crossed whenever a patient has his or her capacities enhanced beyond the level necessary for prevention. Making an individual taller whose natural height falls within (though near the bottom of) a normal range for humans could only speciously be termed a prevention-focused intervention. There is no evidence that this intervention would be effective in preventing future deviation from normal health functioning, and this intervention therefore would not serve as affecting a legitimate healthcare need.

On the other hand, polio vaccination ☐ an enhancement of normally functioning human health capacities ☐ is clearly effective in preventing future functional declines due to the poliovirus. Because polio vaccination satisfies the criteria for proper medical intervention stated by Juengst: "The central purpose of preventative health care is to

maintain the range of opportunity and functional efficiency threatened by disease and disability. Successful preventative health care preserves for people the range of capabilities they have in the absence of pathological conditions, or prevents further deterioration.”

The line is clear: a ‘height handicap’ which does not cause a decrease in normal functioning does not threaten the patient’s range of opportunity or functional efficiency; it does not inhibit the patient’s capabilities they would have in the absence of that condition, nor cause further deterioration in those capacities. It therefore does not fall within the proper domain of medical practice as described by the Normal Function account.

The poliovirus, however, threatens a patient’s range of opportunity and functional efficiency, and its prevention (through vaccination) preserves the patients’ range of capabilities they would have in absence of the poliovirus and prevents further deterioration due to the poliovirus.

Hence, I conclude that legitimate and illegitimate enhancement-preventative medical intervention *can* be reliably distinguished on the Normal Function account. Juengst concludes the contrary, and thus rejects the ontology of disease inherent to the Normal Function account (disease is decrease in normal function and health capacities of a patient). In its stead he proffers a medically reductive ontology of disease which considers medical explanations as being able to be “reduced, ultimately, to accounts of the behavior of these specific causes: germs, poisons, lesions, and genes.” He regards diseases as being reifiable to at least the same extent as Normal Functionalist’s decreases in normal human functioning.

We do not have to resort to this medically reductive ontology of disease, and can retain the Normal Function account in considering enhancement-preventative interventions in the context of deep brain stimulation. Further, it is clear that a line can be drawn between legitimate and illegitimate enhancement on the Normal Function account of medicine, namely by considering the Normal Functionalist statement of the central purpose of preventative medicine as stated above.

II.

With an idea of the ethical debates surrounding the enhancement-therapy distinction in mind, I continue with a summary of the Deep Brain Stimulation (DBS), and its application, risks, and ethically relevant concerns. DBS is a neurosurgical procedure effective in treating symptoms from a range of conditions, especially movement disorders and psychiatric illnesses. The most common application of DBS is to treat the symptoms of Parkinson's Disease (PD); it can also be used to help treat other movement disorders such as essential tremor and dystonia. Recently, Deep Brain Stimulation was approved by the FDA for use in treating obsessive compulsive disorder (OCD).⁸

DBS for patients with PD is aimed primarily at reducing symptoms when medications fail to be ideally effective. This may be to stabilize erratic fluctuations in response to medications, reduce dyskinesia, tremors, or rigidity, or improve the slowing of

⁸ FDA 2009.

patient movement.⁹ There is some evidence that DBS may have neuroprotective effects for patients with PD; that is, DBS may protect against future neurological deterioration.¹⁰

There is uncertainty to what extent DBS can *slow* the progression of PD, but it is worth noting that at present DBS is not understood to *halt* the progression of PD.¹¹

For patients with PD, DBS can improve symptoms by 50 percent, which benefits can last for several years.¹² Results may differ due to variations in placement of the DBS lead (or electrode) and the calibration of device settings. Cases of DBS for patients with essential tremor or dystonia are less numerous than for patients with PD, but the treatment is employed with similar treatment objectives in mind. It is notable that DBS has been approved for use in blinded studies, and a significant benefit of DBS (as contrasted with, for instance, intentional lesioning) is that the effects are reversible.

The potential for DBS for patients with psychiatric illnesses is a burgeoning area of interest for neurosurgeons, neurologists, psychiatrists and bioethicists. At present, DBS for patients with OCD is the primary application of DBS for psychiatric illness. DBS is not a cure for OCD, but patients have experienced an average of a 40 percent reduction in symptoms twelve months after therapy, and the majority suffered only mild adverse complications.¹³ Even many of these were significantly reduced or eliminated when proper adjustments

⁹ Mayo 2014.

¹⁰ Charles 2008.

¹¹ Mayo 2014.

¹² Krack et al 2003.

¹³ FDA 2009.

were made to the device. OCD patients are likely to remain symptomatic, and they may continue to require medications.¹⁴

The surgery involves a DBS system composed of three parts: an electrode (or lead), an extension, and a neurostimulator.¹⁵ The lead is a small, insulated wire inserted through a hole in the skull and placed in the brain, with the tip of the wire in the targeted brain area. The extension is an additional insulated wire passing from the lead to the neurostimulator, under the skin of the head, neck, and shoulder. The neurostimulator is a small electrical generator (may also be called a pulse generator) which is often implanted below the collarbone and generates an electrical impulse. The DBS system functions by electrically stimulating certain areas of the brain which block abnormal nerve signals, but the specific mechanism of action is undetermined.¹⁶ In certain cases, two systems may be implanted to stimulate both sides of the brain.¹⁷

Deep brain stimulation is an effective and relatively safe neurological procedure. There is however, a genuine possibility for a range of post-operative complications.¹⁸ The following table provides a summary of these complications.¹⁹

Post-Operative Complication	Percent of Procedures
Asymptomatic Intracranial Bleed	10

¹⁴ FDA 2009.

¹⁵ National Parkinson Foundation 2015.

¹⁶ Montgomery and Cox 2008.

¹⁷ FDA 2009.

¹⁸ NINDS 2015.

¹⁹ Robinson 2006.

Symptomatic Intracranial Bleed	2
Seizures	3
Headache	25
Infection	6
Required Lead Replacement	9
Required Lead Repositioning	8
Required Extension Wire Replacement	6
Required Neurostimulator Replacement	17
Death	<1

Potential for Future Implementation

The future for DBS includes potential application in the treatment of the following conditions:

Epilepsy

Up to 1 percent of Americans are afflicted by medically refractive epilepsy. The centromedian and anterior nucleus of the thalamus have been highlighted as potential locations for DBS to reduce seizures in medically refractive epileptic patients. After encouraging reductions in seizures in a 2010 study, the European Union approved DBS of

the anterior nucleus of the thalamus for treatment of epilepsy.²⁰ The United states has yet to approve the same treatment – possibly because the anterior nucleus of the thalamus is a large area, and a more specific portion of the AN has not been determined for ideal results of stimulation.²¹

Cluster Headache

A patient suffering from cluster headaches will experience severe, cyclical headaches lasting for weeks or months, which in up to 20 percent of patients are medically refractory (that is, symptoms persist despite medical efforts). As of 2010 there had been approximately 50 cases of DBS for cluster headaches, , and some promising results have given hope for the use of DBS for cluster headaches in the future.²²²³

Gilles de la Tourette Syndrome

Affecting nearly 1 percent of children, Gilles de la Tourette syndrome (GTS) is a neuropsychiatric disorder producing phonic, vocal, and motor tics which typically disappear by the time patients reach 20 years of age. In cases which do not, DBS may be a viable treatment option, with encouraging reductions in symptoms resulting from DBS of a range of areas in the brain. The optimal target is yet to be determined, and so at present the following are all considered potentially suitable candidates for DBS: centromedian, ventral oralis internus nuclei of the thalamus, globus pallidus internus, nucleus accumbens, and

²⁰ Fisher et al. 2010.

²¹ Lyons 2011.

²² Lyons 2011.

²³ Brown 2008.

anterior limb of the internal capsule. DBS for GTS would at present be considered only for the most severely afflicted and medically refractory patients; it is a last resort kind of option for GTS.²⁴

Depression

In approximately 20 percent of patients suffering from clinical depression, the disease is sufficiently medically refractory that DBS is a viable treatment consideration. Technique and risk are similar for depression patients as patients with PD, but the targeted brain areas differ. Two important studies highlight subgenual cingulate in Brodmann area 25, the ventral striatum or the nucleus accumbens as potentially useful targets for widespread application of DBS for medically refractory clinical depression.²⁵ It is worth noting that an adverse effect of DBS for PD is depression **in some percentage** of patients.

Chronic Pain

Several studies have suggested the efficacy of DBS in treating chronic pain including back, leg, facial, phantom limb, or stroke pain. Two target areas are the somatosensory thalamus and the periventricular gray region.²⁶

Aggressive Behavior

²⁴ Brown 2008.

²⁵ Mayberg et al. 2005., **Schaeffer et al. (Brown 2008)**.

²⁶ Brown.

In particularly challenging cases of impulsive and medically refractory aggressive behavior, lesional therapies on the hypothalamus have successfully reduced aggressive behavior.²⁷ Recently, aggressive behavior has been reduced in a few patients through DBS of the hypothalamus. A few studies have published hopeful results in this regard.²⁸

Obesity and Addiction

The lateral hypothalamus and ventromedial hypothalamus -- the appetite and satiety centers of the brain, respectively -- are potential targets for DBS for the treatment of Obesity. An additional option is the nucleus accumbens, the brain's reward center. Regulation of obesity and addiction are likely to be related to the nucleus accumbens. It is worth noting that obesity has developed in some patients with PD who underwent DBS.²⁹

Camptocormia

Camptocormia is a condition causing involuntary flexion of the trunk when standing or sitting; this condition is associated with idiopathic PD. Research has suggested that PD patients with camptocormia are likely to benefit from bilateral DBS of the globus pallidus internus.

Restless Legs Syndrome

²⁷ Lyons 2011.

²⁸ Lyons 2011.

²⁹ Lyons 2011.

RLS affects up to 25 percent of adults, with a potentially greater percentage of PD patients suffering from RLS. In PD patients with RLS, DBS is likely to be an effective method of treatment as research develops.³⁰

Alzheimer disease

In Alzheimer's disease (AD), DBS be effective in preventing neurological degeneration in Alzheimer's patients. In particular, DBS of the fornix/hypothalamus has been effective in increasing glucose metabolism in temporal and cortical areas in both one month and one year after DBS, with patients also showing "improvement or slowing of anticipated decline at 6 and 12 months after DBS".³¹³² Discovery that DBS is a viable means of treatment or prevention of neurological decline in AD patients would be a significant achievement, as no other means of effective treatment are available.

III

I continue with a review of the bioethical context of DBS, with emphasis on issues pertinent to DBS for prevention. To begin, it is worthwhile to discuss in what ways DBS is distinct from psychosurgical procedures like lobotomy or other controversial and potentially abused "medical" neurological intervention. First, DBS is safer. The risks associated with DBS are minimal when compared to most brain surgeries. While still highly

³⁰ Lyons 2011.

³¹ Lyons 2011.

³² *Hamani et al*¹⁵

invasive and therefore entailing risk, DBS is considered much safer than alternative neurosurgical therapies.

Furthermore, the effects of DBS are reversible and adjustable. If patients fail to respond to electrical stimulation, the electrodes can be turned off, and patients will cease to experience the effects of electrical stimulation. That said, damage caused by mishaps during surgery (for example, unintended damage to a certain part of the brain) cannot be undone by turning off electrical stimulation. An additional point is that DBS is adjustable in light of patient response to initial stimulation. Over the first few months after surgery, settings can be noninvasively calibrated to maximize patient benefit. This is a fairly unique aspect of DBS.

Finally, it is worth noting that DBS is used as a last resort option only for patients who are refractory to other available medical therapies. A patient will not be rushed off to surgery for DBS immediately after being diagnosed with clinical depression. Rather, patients would only receive the neurosurgery after other efforts at treatment had been unsuccessful or unsatisfactorily successful.

Exploring the consequences of Childress and Beauchamp's four bioethical principles for DBS will be helpful in considering the ethical implications of DBS. These are beneficence, non-maleficence, autonomy, and justice. I begin with beneficence and non-maleficence.

Beneficence and Non-maleficence

To justify DBS, it is uncontroversial that there must be a proportionally great benefit for the patient compared to the potential harms of the operation. How this evaluation of pros and cons is resolved will depend on the individual patient and disease context. For example, a more serious case may justify a relatively greater risk for the patient. The potential unintended effects of DBS are discussed above.

Here I will focus on the potential psychosocial impact of the surgery. These side effects directly affecting patient quality of life can be broken down roughly into issues of social wellbeing, emotional stability and contentment, and identity. It has been said that in DBS the case is often that “the doctor is happy, the patient less so”.³³ Social consequences can include deteriorated interpersonal relationships or social support, paradoxically harming patient quality of life even as symptoms improve significantly. Improvement of symptoms may in some cases interrupt social and relational patterns, requiring adjustment after surgery. Emotionally, some patients have been found to experience depression (or general decreased emotional wellbeing) after the surgery.

It may be that these consequences result from unrealistic expectations about the results of DBS in the patient.³⁴ This result speaks to the imperative of providing all relevant information about the surgery to patients, with emphasis on reasonable expectations for life during and after DBS. This may be enough to resolve the discussed negative emotional and social consequences possible after DBS.

³³ Agid Y et al. (2006). Neurosurgery in Parkinson's patients: the doctor is happy, the patient less so? *J. Neural Transm.* 70, 409 doi: 41410.1007/978-3-211-45295-0_61 [[PubMed](#)] [[Cross Ref](#)]

³⁴ Schermer 2011.

Issues of identity present another ethical worry related to DBS. When patients go through brain surgery which alters emotion, cognition, or perspective some patients may to some extent dissociate with their former selves. A severely clinically depressed patient may find he is unfamiliar with himself when he no longer feels the same torturous sadness after DBS. As pointed out by Grant et al., DBS thus entails challenges relating to narrative identity, or the broad concept of one's self based on a reflective narrative endorsed by an individual. DBS understandably may disrupt this narrative identity by bringing about a significant shift in a person. Even if this shift is an objective good, it may be unsettling to the patient. So, we should be aware of these "transition costs", and make the patient aware of them.

Alterations in narrative identity are neither necessarily bad nor good; they may be either in differing circumstances. However, it is worth considering the implications this might have for patient wellbeing, and medical professionals should take note of the potentiality for negative consequences. Brown 2008 comments that "treating behavioral disorders is not altering the patient's personality; it is allowing them to reclaim the personality lost to the respective illness." This draws an analogy to Dr. Peter Kramer (*Listening to Prozac*) who might claim that treatment of depression does not alter a person, but instead returns them to whom they have always been underneath the disease.

Autonomy

In the context of DBS, concerns about autonomy highlight the question of how much control a patient should have over the surgery and subsequent stimulation. It is, for

example, an open question as to whether patients as well as physicians should have the capacity to alter the settings of the electrode stimulation if they desire. This would enhance autonomy, but it may be significantly detrimental to the patient if excessive stimulation is likely to be sought and would be dangerous.

Whether or not patients should be able to undergo elective deep brain stimulation is an additional question relating to autonomy. Particularly with regards to DBS for enhancement purposes, members of society may be concerned about the availability of DBS to achieve electrical stimulation of memory and attention centers in order to enhance academic performance. This issue is relevant to DBS for prevention purposes as well, raising the question of whether DBS must be prescribed by a physician or if a patient (with early stage Alzheimer's disease, for example) should have the right to seek neuroprotective or preventative DBS without a physician's explicit suggestion. An additional issue for DBS with respect to autonomy is the question of consent, which I will focus on in the next section.

Justice

Justice in the context of DBS highlights issues of patient selection, consent, and resource allocation. Bell et al. 2009 sum up patient selection: "patients need to stand a good chance to benefit from the procedure, have severe functional impairments and be refractory to other, less invasive or less burdensome, treatments. Also, candidates should be physically, cognitively, and emotionally capable of tolerating surgery and participating

in postoperative care.”³⁵ Central to patient selection is confirmation of competence for informed consent to DBS and the associated neurosurgery. Grant et al. argue this means all patients should receive “thorough neuropsychological examination” in order to bring to light cognitive deficits or other psychiatric comorbidities.³⁶

A clear issue with competence in the context of DBS is that the patients who need DBS may be sufficiently impaired that they do not meet the requirement that they are physically, cognitively, and emotionally capable of tolerating surgery and postoperative care. Those who need the treatment most may not be eligible based on this definition of competence. These issues may be more challenging in the context of psychiatric illnesses.

Grant et al. claim that despite psychiatric illness, most suffering from DBS-relevant illnesses will be competent for the purposes of informed consent. “A clinical diagnosis does not imply decisional incapacity nor should it rule such capacity out, as many patients demonstrate retained abilities to understand risks, benefits, and potential complications.”³⁷ The question of consent in the context of psychiatric illness is worth serious consideration.

A final issue with respect to justice and DBS is the question of resource allocation. At present DBS costs about \$80,000 per patient, and only a select group of surgical teams have the training and resources necessary for successful DBS. This brings up the issue that, at present, decisions must be made about who will receive DBS treatment, who will bear the

³⁵ Bell et al., 2009.

³⁶ Grant et al.

³⁷ Grant et al.

costs, and whether there is some moral duty to expand access to the treatment for approved diseases.³⁸

Technological advances will significantly alter many of the ethical concerns presently associated with DBS. Improved surgical techniques and technologies may reduce the physical risks of DBS. However, many issues will not disappear due to advances in technology or availability. One such concern is the potential to negatively impact the narrative identity of a patient. Another concern that will not be eliminated by technology is the question of where the line is drawn between therapy and enhancement in the context of DBS.

IV

So, the line between enhancement for disease prevention (legitimate) and illegitimate enhancement has been established based on the Normal Function account of medicine. In the context of deep brain stimulation, legitimate enhancement for disease prevention would involve enhancing human capacities in the brain in order to maintain the range of opportunity and functional efficiency threatened by disease and disability, and it would preserve a patient's range of capabilities or prevent future deterioration in health status. An enhancement to, for instance, reliably fend off neurological deterioration from Alzheimer's disease by stimulating memory centers in the brain would be an ethically viable enhancement for disease prevention on the Normal Function account. On the other

³⁸ A further question relating to justice and autonomy in DBS is the potential for DBS to be used as a means of correcting immoral behavior in the context of, say, particularly violently aggressive criminals. Whether consent must be required for such a situation is a question which must be confronted, and it also falls far from the scope of this paper.

hand, DBS for a healthy patient to ensure that they could, for example, focus for fifty hours to cram for a test would be an illegitimate intervention because it would not be effective in preventing any clear threats to future functioning.

Applications of DBS for Disease Prevention

In discussing the immediate practical relevance of DBS for disease prevention, I will focus on Temporal Lobe Epilepsy (TLE) and Parkinson's Disease (PD). The potential of using DBS for disease prevention (alternatively, neuroprotective DBS) is now a burgeoning possibility in medical research, with both TLE and PD being studied and returning hopeful results.

Parkinson's Disease

Charles et al. (2008) announced a study to investigate the neuroprotective benefits of DBS for Parkinson's patients. The authors state that "we believe that DBS slows the progression of PD, and we are currently conducting a pilot clinical trial of B-STN DBS in early-stage PD (ClinicalTrials.gov identifier NCT00282152)". The research concluded in late 2014. As of writing this paper no results have been published.

Intractable epilepsy

Chen et al. (2013) suggest a neuroprotective effect of DBS of the anterior nucleus of the thalamus (ANT). Goodman et al. (2005) found that preemptive stimulation in epileptic rats

significantly reduced the incidence of stage five seizures by more than 50% compared to a control group.

Depression

Little research was found on the potential to use DBS to prevent depression, but this is an area of great viability and controversy in discussions of DBS.

Controversy and Other Considerations

It was mentioned above that preventative enhancements are acknowledged as ethically acceptable to the Normal Functionalists while enhancements which neither treat a current decline in functioning nor an imminent threat to functional declines are regarded to be illegitimate. It is good that the latter is considered illegitimate because this is the kind of intervention which incites *Infinite Jest* levels of paranoia about the direction of society and the role of medicine in it. What if DBS became the new ADD prescription? What if a nefarious dictator employed DBS to control her subjects? What if everyone had electrodes implanted in pleasure centers of the brain, and they were provided with total control over the stimulation? These worries give us valuable benchmarks for situations in which we hope DBS will not be applied.

A further consideration, mentioned previously in this paper, concerning DBS is the potential for risk to the patient through surgery for DBS. DBS still requires invasive brain surgery. Such operations involve risk, and so the case for DBS in an asymptomatic patient is likely to be a tough sell, even if the asymptomatic patient has just been diagnosed with PD

or Alzheimer's and could benefit significantly from the surgery. Without symptoms, brain surgery for DBS may not be highly sought after.

V. Conclusion

To conclude, the state of DBS for prevention is to be a subject of intense research and innovation in the coming years, and the ethical justification for surgery and stimulation will depend significantly on the results of these advances. The Normal Function account can reliably distinguish between legitimate and illegitimate enhancement in the context of DBS. The ethical acceptability of DBS for all patients will depend on the disease, available technology, and individual patient situation.

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