Chapter 9
Better Brains or Bitter Brains? The Ethics of Neuroenhancement

Kirsten Brukamp

Abstract The topic of enhancement emerges as a novel, contemporary problem in medical ethics. In particular, neuroenhancement reveals itself as a challenging subject due to the advancements of neuroscience. At present, pharmacological neuroenhancement is widely debated, but only scarce empirical data exist regarding its prevalence. Arguments for and against neuroenhancement relate to various disciplines, such as medicine, anthropology, sociology, and classical ethics. Medical considerations caution against the use of pharmaceutical neuroenhancers because of medical risks, the lack of evidence-based medicine, and financial challenges to health care systems. Perspectives on neuroenhancement from the humanities involve the concepts of human nature, virtue ethics, liberty, and justice. The purposes behind neuroenhancement are disputable with regard to their social value. In conclusion, neuroenhancement appears to remain a controversial phenomenon.

Keywords Neuroenhancement • Medical ethics • Medical risks • Evidence-based medicine • Liberty • Justice

9.1 Overview

This short overview summarizes the contents of the paper and provides the section titles in parentheses: A brief outline sketches potential "Approaches in Medical Ethics" that help to address the moral problems of pharmacological neuroenhancement. A pragmatic method is chosen in order to weigh arguments from various standpoints. The introduction to "Definitions and Classifications" clarifies the terminology related to neuroenhancement.

K. Brukamp (✉)
Institute for History, Theory, and Ethics of Medicine, RWTH Aachen University, University Hospital Aachen, Aachen, Germany
e-mail: kbrukamp@ukaachen.de

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The following subdivisions provide pro and con arguments from different perspectives and disciplines, such as medicine, anthropology, sociology, and classical ethics. With regard to the medical field, the section "Medical Risks" argues against the spread of pharmacological neuroenhancement because of medical complications, while the section "The Lack of Evidence-Based Medicine" highlights the lack of evidence for the claim that neuroenhancement is beneficial. The subsequent section, "Challenges to Health Care Systems," discusses the potential economic difficulties that desires for enhancement may bring about. Considering the humanities, the section "Human Nature and Virtue Ethics" presents concepts that critics of neuroenhancement frequently refer to in their arguments. The section on "Debatable Purposes" sketches the differential purposes of neuroenhancing *versus* recreational drug use, differences that are oftentimes not explicitly addressed in the ethical debate. The section "Liberty and Justice" discusses fundamental concepts in practical philosophy and points out how their application to pharmacological neuroenhancement yields ambivalent results. Finally, the "Conclusions" recapitulate the considerations, which result in an overall rather skeptical assessment of pharmacological neuroenhancement.

9.2 Approaches in Medical Ethics

Neuroenhancement increasingly proves itself as a relevant topic in society, and it carries important financial implications with it. Neuroenhancement is a problem for the discipline of medical ethics, and medical ethics is expected to fulfill the following roles, among others:

1. to *recognize* topics of discussion in medical ethics that possess high relevance for society as a whole and to *inform* the public about them,
2. to *structure and summarize arguments* in order to improve the level of deliberations and make them more efficient, and
3. to provide a weighted *conclusion* or to give practical *advice*, when they are sought after, based on the knowledge gained in the previous steps.

Approaches on how to tackle problems in medical ethics differ according to the theories, values, and principles that are applied. One possibility is to begin with an ethical metatheory, such as virtue ethics, deontology, or consequentialism (Beauchamp and Childress 2009), and to develop a consistent system out of this meta-theory to solve existing problems. However, this method has neither proven practical nor efficient in the discussion of clinical case studies. As a result, the approach of principlism has become a strong and well-known current in modern medical ethics. According to principlism, a few predominant and far-reaching principles appear to serve as excellent means for balancing the interests of patients, namely the principles of autonomy, beneficence, non-maleficence, and justice (Beauchamp and Childress 2009).

In bioethics, as elsewhere, people tend to dwell on the apparent dichotomy between conservative and liberal positions. These respective positions may be summarized succinctly and colloquially as "It is best that people stay as they were" *versus* "Let the people decide for themselves." Nevertheless, opinions in the neuroenhancement debate, as with other bioethical topics, are not necessarily divided according to the highly superficial stereotypes of these dichotomous positions (Parens 2005).

Here, the focus will be on discourse and pragmatism (Racine 2010) in order to reach actual answers to practical questions. Some specific ones arising from the topic ask: Should people use pharmacological neuroenhancement? Should neuroenhancers be over-the-counter medication? Should physicians prescribe pharmacological neuroenhancers? How should the consequences be dealt with legally, ethically, and financially? In the following sections, after an introductory clarification of terms, pro and con arguments from different disciplines and viewpoints will be presented in order to arrive at a credible conclusion.

9.3 Definitions and Classifications

Enhancement comprises strategies to improve one's bodily appearance or functioning by medical means, although the client is healthy and not considered a patient. This latter judgment occurs relative to a presumed objective standard of normalcy, which is, of course, debatable, culture-specific, and ever-changing. Medical knowledge is utilized outside the classical medical system, and enhancement transcends the typical medical purposes of therapy, prevention, rehabilitation, and palliative care. The desire for enhancement is subjective, and it aims at personal satisfaction and mood improvement. Examples include aesthetic surgery, doping with performance-enhancing drugs in sports, and anti-aging medication. Neuroenhancement is correspondingly an enhancement concerning the nervous system. Given that potential options for neuroenhancement are still in development, two preliminary ways of classification currently make sense (Brukamp and Groß 2012):

1. *Functions*: Neuroenhancement may be geared towards diverse functions of the brain. In particular, the following pursuits are feasible:
    1.1. *Cognitive enhancement*: Its goal is to improve wakefulness, attention, concentration, intelligence, memory, and executive functions. Examples for medication candidates include methylphenidate, modafinil, anti-dementia medication, and amphetamine derivatives.
    1.2. *Mood enhancement*: Its aim is to brighten emotional states. Examples are selective serotonin reuptake inhibitors (SSRIs), such as fluoxetine.
    1.3. *Moral enhancement*: It is meant to improve social behavior, and one of its presumed mechanisms of action is to increase a subject's empathy for others. Candidates include oxytocin and 3,4-methylenedioxymethamphetamine

(MDMA), the latter of which possesses an additional mood enhancement component. Nevertheless, at present, medical knowledge is insufficient to precisely utilize potential moral enhancers for this particular purpose. Therefore, moral enhancement to improve social behavior remains speculative overall.

1.4. *Various effects*: Moreover, some neurotropic medications have been noted to lead to extraordinary sensory impressions and transient feelings of pleasure. Others increase the pain threshold in healthy individuals. Many medications that act on the central nervous system may be regarded as neuroenhancers depending upon the purpose and the context in which they are used.

2. *Methods*: Neuroenhancement may involve varying techniques and devices. Only a subset of them is debated because of moral concerns. In a broad sense, the term "neuroenhancement" also refers to such innocuous methods as sufficient sleep, adequate nutrition, physical exercise, the use of mnemonic techniques, and brain training. Since these methods cause no or few moral problems, they are neglected in the ethical discussion. However, the moral issues of the following types of neuroenhancement in the narrow sense have been recognized:

   2.1. *Pharmacological enhancement*: At the present time, the use of medication remains the most frequent strategy for attaining neuroenhancement. The drugs utilized either originate from medication intended for therapeutic purposes, or they stem from illegal substances.
   2.2. *Non-invasive technology*: An enhancement potential may exist for transcranial stimulation techniques that are currently in development, such as transcranial magnetic stimulation (TMS) or transcranial direct current stimulation (tDCS).
   2.3. *Implanted technology*: Neuroenhancement might also involve invasive technology in the future, e.g. in the format of brain implants.

In the following, only pharmacological neuroenhancement will be specifically addressed because this approach currently has the highest prevalence. Still, most arguments can be extrapolated and modified in order to apply to the other ethically controversial means of neuroenhancement as well.

9.4 Medical Risks

From a medical perspective, neuroenhancement possesses indisputable risks. Consequently, medical considerations inevitably give rise to counterarguments against its use (Brukamp and Groß 2012). Potential risks of pharmacological neuroenhancement include the following:

1. *Side effects*: Every medication has a characteristic side effect profile. Although some side effects may be negligible or acutely tolerable, long-term effects cannot reliably be predicted for the vast majority of novel pharmaceutical

agents. One difficulty in estimating long-term effects stems from the fact that the mechanisms of action are oftentimes not fully understood. The effects of neurotropic medications cannot usually be switched off immediately by simply stopping the medication. Depending on the substance, the effect may cease only after several days. For most neuropharmaceuticals in medical use today, it is dangerous to not use a gradual dose reduction in order to taper or fade out the medication.

2. *Risk of addiction*: Some medications show a high potency to induce physical or psychological dependence.
3. *Loss of efficacy over time*: In some cases, medications lose their therapeutic effects during prolonged use. Higher and higher doses, or therapeutic combinations with other medications, are then required to achieve the same effect. Undesirable side effects can be augmented this way.
4. *Overestimation of one's own abilities*: Some medications do not improve objective performance, but they merely induce the subjective impression of better functioning instead. Modafinil apparently shows this effect: In a study, experimental examinees were subjected to prolonged sleep deprivation. Subjects with simultaneous modafinil use felt that their wakefulness increased although their cognitive performance was not better, and they overestimated their own abilities (Repantis et al. 2010b). This phenomenon provides a strong case against neuroenhancement strategies because it may endanger the safety and health of oneself and of others. For the same reason, alcohol is discouraged before driving, or altogether prohibited in some jurisdictions, because users fail to realize their own impairments and do not adjust their behavior accordingly in traffic.

Physicians' safety concerns limit the prescription of neuroenhancers in practice. A study found that primary care physicians in North American urban areas were surprisingly uncomfortable with prescribing enhancers (Banjo et al. 2010):

> [. . .] the most prominent concerns physicians expressed were issues of safety that were not offset by the benefit afforded the individual [. . .] It has become routine for safety to be raised and summarily dismissed as an issue in the debate over pharmacological cognitive enhancement; the observation that physicians were so skeptical [. . .] suggests that such a conclusion may be premature. Thus, physician attitudes suggest that greater weight be placed upon the balance between safety and benefit in consideration of pharmacological cognitive enhancement. (Banjo et al. 2010)

9.5 The Lack of Evidence-Based Medicine

Evidence-based medicine is a practice of medicine that is informed by documented evidence for the efficacy of its interventions. The available evidence is ranked according to well-defined categories of quality standards. In particular, meta-analyses are appreciated most, followed by randomized and controlled trials, studies, reviews, and expert opinions, in declining order of respect (Sackett et al. 1996).

Reviews of empirical studies examined the potentially discernible effects of methylphenidate, modafinil, and acetylcholinesterase inhibitors in healthy humans (Repantis et al. 2010a, b). The conclusions were as follows: Methylphenidate improves memory, and modafinil increases wakefulness, both under normal conditions and after sleep deprivation, but the latter also potentially induces unsubstantiated overconfidence in one's own abilities (Repantis et al. 2010b). Aside from these results, no valid inferences are possible due to a lack of data, specifically in the case of acetylcholinesterase inhibitors (Repantis et al. 2010a; see also Chap. 3 by D. Repantis, this volume).

This relative lack of evidence is disturbing in light of the quality measures for medication that is intended for medical therapies: The later is typically tested in randomized, controlled, double-blind trials, and it is compared to other medication that has already been shown to be effective. Therefore, the hurdles are higher for the new drug, and it has to be proven to be as valuable and successful in comparison to an already established treatment regimen.

Pharmacological neuroenhancers probably possess relevant placebo effects. Positive outcomes may not be caused by the supposedly active pharmaceutical substance, but rather by the overall treatment conditions, including the psychological *sequelae* that arise from the patient's or client's attributions or perceptions. Such effects have even been demonstrated for antidepressants in severely depressed patients (Kirsch et al. 2008).

Which criteria does medication have to fulfill in order to become fully accepted in medicine and justified for reimbursement by health insurance companies? To give an example, antihypertensive medication is, at first sight, assessed regarding its ability to lower blood pressure. Nevertheless, this goal is not the only one that needs to be achieved in order to count this medication among the truly deserving, effective health care measures. For the latter, additional benefits need to be shown. Antihypertensive medication should prevent the numerous complications of elevated blood pressure, e.g. atherosclerosis, coronary artery disease, myocardial infarction, cardiac failure, arrhythmia, stroke, and the ensuing medical fatalities.

Therefore, antihypertensive medication that merely lowers blood pressure is not considered particularly valuable in scientific medicine. The prevention of severe complications and fatalities are considered worthier goals. Long-term medical studies aim at showing these benefits, and they require more time and labor in order to prove these distant benefits. For the overall assessment, minor short-term effects need to be neglected in favor of significant beneficial or detrimental long-term outcomes.

An application of this concept from evidence-based medicine to pharmacological neuroenhancers provides a very strong challenge to their use (Brukamp and Groß 2012). First of all, enhancing short-term effects are far from obvious at this time. Even if these were shown, the neuroenhancers might still not possess the profound positive medium-term or long-term effects on the quality of life that their proponents envision. The likelihood is rather low that scientific studies will demonstrate that neuroenhancing medications mediate long-term enhancement across cognitive modalities, improve grades and careers overall, and lead to an entirely more

desirable life. According to the principles of evidence-based medicine, all these benefits would need to be proven in comparison to or on top of other, already widely accepted and utilized strategies with lower risks.

9.6 Challenges to Health Care Systems

The desire for enhancement poses a challenge to health care systems because of its potential to deplete assets. Consequently, enhancement might be rejected for this reason. Health care systems are primarily responsible for taking care of patients with medical conditions who need help in deserving situations. When resources are limited, the majority of these resources should be channeled to needy patients. Enhancement endeavors, and neuroenhancement in particular, may divert financial resources away from the classical medical systems as such. For example, additional expenses arise from dealing with complications of pharmaceuticals:

> [. . .] the additional demand for healthcare services needed to mitigate the overall impact of widespread non-medically indicated uses of prescription drugs may place further pressure on current professional and healthcare resources. (Racine and Forlini 2009)

Physicians invest personal resources in the dyadic physician-patient relationship in terms of time, attention, and interest. Addressing enhancement may distract these personal resources away from physicians' priorities. Such a distraction would occur if physicians followed a recommendation like "Neurologists should respond to a request for neuroenhancement as they would respond to a chief complaint." (Larriviere et al. 2009) This recommendation is prominently called "guidance for physicians" by its inventors (Larriviere et al. 2009). The advice seems particularly at odds with the following concurrent statement: "The liability risks associated with prescribing medications for neuroenhancement are uncertain." (Larriviere et al. 2009) Such liability risks leave physicians in a weak legal position when they actually support their patients' desire to enhance.

The neuroenhancement debate calls attention to the problem that commercial interests encroach on the traditional act of prescribing medication, which is initiated by the physicians, not the patients. In light of the poor medical evidence in support of neuroenhancers, some pharmaceutical companies attempt to replace objective information with marketing. Direct-to-consumer advertising (DTCA), also called direct-to-consumer marketing, is well-established in the United States of America and in New Zealand. It entails direct advertising of pharmaceutical drugs to consumers, instead of to physicians only. The introduction of some types of direct-to-consumer advertising in Canada has been met with considerable criticism. Its economic potential is estimated as high, and its opponents argue that a significant rise in broadcast advertising results in higher spending on medication (Mintzes et al. 2009). Direct-to-consumer advertising does work in the way that it was intended:

> Our results suggest that more advertising leads to more requests for advertised medicines, and more prescriptions. If DTCA opens a conversation between patients and physicians, that conversation is highly likely to end with a prescription, often despite physician ambivalence about treatment choice. (Mintzes et al. 2003);

> Direct-to-consumer marketing of self-referred imaging services, in both print advertisements and informational brochures, fails to provide prospective consumers with comprehensive balanced information vital to informed autonomous decision making. Professional guidelines and oversight for advertising and promotion of these services are needed. (Illes et al. 2004)

9.7 Human Nature and Virtue Ethics

Critics of neuroenhancement frequently refer to the value that lies in human nature. Key principles of such arguments are the maintenance of, or search for, authenticity, truth, originality, personality, and identity as a human being (Brukamp and Groß 2012). The use of pharmacological neuroenhancers is perceived as deception, self-deception, forgery, or cheating. According to this position, neuroenhancement merely results in an imitation of traits that should be formed by natural means and that are only considered valuable if they have a natural origin. An example for such an argument reads as follows:

> As the power to transform our native powers increases, both in magnitude and refinement, so does the possibility for 'self-alienation' – for losing, confounding, or abandoning our identity. I may get better, stronger, and happier – but I know not how. I am no longer the agent of self-transformation, but a passive patient of transforming powers. Indeed, to the extent that an achievement is the result of some extraneous intervention, it is detachable from the agent whose achievement it purports to be. 'Personal achievements' impersonally achieved are not truly the achievements of persons. (The President's Council on Bioethics 2003)

In contrast, an argument in favor of neuroenhancement relies on a different anthropological assumption about human nature: Humans constantly seek self-improvement. This quest to improve oneself appears as a seemingly incontrovertible human trait, as a core value for humans. Enrichments in daily life are generally accepted, such as measures to increase comfort and bodily embellishments. Merely sticking with the biologically given facts could then equate to an is-ought fallacy in the moral realm. Therefore, the proponents of neuroenhancement argue that medications are just an extension of the methods by which the same goals are pursued. The target of self-improvement remains the same, while the means are broadened to include pharmaceutical support (Galert et al. 2009). The following citation gives an example of such a position:

> Education and training [...] may be labeled as 'conventional' means of enhancing cognition. [...] By contrast, methods of enhancing cognition through 'unconventional' means [...] are nearly all to be regarded as experimental at the present time. [...] They may eventually come to have important consequences for society and even, in the longer run, for the future of humankind. [...] From [...] a comprehensive viewpoint, the inadequacies of some aspects of the current regulatory and policy framework become apparent, as it treats different modes of enhancement differently even though, arguably, there is no good justification for doing so. (Bostrom and Sandberg 2009)

Nevertheless, this latter argument is challenged by the fact that people frequently arrive at logically separate moral judgments about ends (or goals) *versus* means. This distinction has been widely defended in general normative ethics for a long time.

According to virtue ethics, morality originates from within. It depends on a person's personality, her formed habits and persistent traits. Character is more important than individual actions. While good behavior is generally time-invariant, it can be adapted to situations. In its classical form, virtue ethics goes back to Greek and Roman times, but it has seen a successful revival in recent decades. A related contemporary concept is the pursuit of self-improvement by natural means. Bettering one's habits can strengthen one's self-esteem and bring about greater satisfaction and happiness. This process influences and gradually constitutes one's identity. The methods of forming habits can take on manifold formats: behavioral practice, cognitive training, reflective reasoning, sports, sleep, or meditation. These ways of shaping behavior are socially widely accepted and have been used across cultures and time.

Supporters of virtue ethics and natural self-improvement ascribe value to the progressive shaping of behavior, to striving for improvement and perfection. Positive changes are achieved by gradual movements in the right direction. On the contrary, pharmacological neuroenhancement is regarded as an external, artificial measure that merely serves as a means of self-deception. Consequently, it is customarily rejected.

One counterargument to the latter position asserts that enhancement would be recommendable in the format of moral enhancement, even if natural self-improvement surpassed pharmacological cognitive and emotional enhancement. Regarding moral behavior, the thresholds and obstacles for achieving behavioral corrections are usually much higher than for cognitive and emotional contexts. However, this argument is invalid because moral enhancement concerns only specific subgroups of the population that are amenable to therapies proper:

At present, the improvement of social behavior is only desirable and advisable for people with significant impairments in their moral fabric. This applies predominantly to criminal offenders who commit crimes because of an underlying psychiatric disorder associated with aggression, such as an anti-social personality disorder (American Psychiatric Association 2000; World Health Organization 2007). In these cases, an offer of medication, in addition to or instead of other retaliation measures, may be beneficial for both themselves and society as a whole.

Such an approach is not wish-fulfilling enhancement, though. Rather, it is a medically justified treatment since personality disorders constitute psychiatric diagnoses with clear-cut medical treatment options (American Psychiatric Association 2000; World Health Organization 2007). In short, therapies targeted against criminal behavior as part of psychiatric disorders need to be correctly designated as moral treatments, not moral enhancements.

9.8 Debatable Purposes

Supporters of neuroenhancement often emphasize the common desire to pursue success. The concept of success is certainly subjective, and humans search for success in a number of different ways, for example through competition. Pharmacological neuroenhancers promise apparent advantages for competition in schools, at universities, or at work. An additional motive for use is the goal to experience pleasure and fun, e.g. by refueling energy for partying and dancing for many hours in a row. In such instances, those who do not use neuroenhancers are then regarded as socially inept or potential failures.

Survey studies found an association between poor performance and neuroenhancer use (Franke et al. 2011). This phenomenon seems to suggest that underachievers feel more pressure to utilize medications than the top of the class. However, an alternative interpretation proposes that a group somewhat disadvantaged from the outset is inclined to use a variety of drugs at the same time, including legal, illegal, and prescription drugs. Drugs may then lead to further negative effects on users' performance in school or at work. Overall, empirical data on the prevalence of neuroenhancement are scarce (Hildt 2011). One informal survey reporting a rather high prevalence (Maher 2008) does not meet the quality criteria of research methods in empirical social science in order to draw meaningful conclusions.

The pursuit of success can become strained. Some users of pharmacological neuroenhancers seem to care mostly about self-interest, such as through competition, careerism, conformity, effort, work, and tangible achievements. Factors that may be underrepresented in this framework are relaxation, release of tension, play, individualism, and spiritual experience.

One important question in this context is: For which purposes do healthy people use non-medical drugs voluntarily? The answer has apparently changed over time. During the 1960s and 1970s, most people gravitated towards drug use for relaxation purposes. Some of them sought a spiritual element that would help them to identify meaning in their lives. One goal was to display disdain with the mainstream culture. Drug use seemed to open up an alternative to the perceived restrictions and limitations in society. To some followers, it promised to provide a break from conformism and from the hunt for power and money. Doubts remain whether these expectations were fulfilled, in light of the side effects of illegal drugs.

A look at the purposes for neuroenhancer use today shows a completely different picture because these purposes are, in part, contrary to those of recreational drugs. Neuroenhancers supposedly enable people to better comply with the demands of the mainstream attitudes on achievements in school, academia, and the workplace. Consumers wish to attain common, widely accepted goals. For example, self-perceived underachievers seize apparent opportunities in order to integrate more completely into society.

The discrepancy between these two groups of voluntary drug users leads to the question whether both purposes have their respective value, depending on

the context. In some situations, people want to exercise their individualism by distinguishing themselves from the mainstream, whereas others seek to achieve a high level of success in order to adhere to the norms of the predominant culture. In any event, the discrepancy shows that the fashions of drug use are culture-relative and change with time. This phenomenon may instill a sense of caution against pharmacological neuroenhancement.

9.9 Liberty and Justice

One of the major arguments in favor of pharmacological neuroenhancement, which has frequently been put forth, is the argument of liberty. Personal autonomy in the setting of democratic freedom should guarantee individualism and the pursuit of distinct goals. The conclusion is that everyone may decide for herself whether or not to use neuroenhancement. Proponents then take a "why not?" position and support a so-called responsible version of drug use (Metzinger 2006; Greely et al. 2008).

Nevertheless, in democratic societies, legitimate interests of others place limitations on the unconstrained pursuit of individual goals. Which arguments may tilt the balance against the acceptance of pharmacological neuroenhancers?

One argument relies on the concept of distributive justice (Brukamp and Groß 2012). It claims that personal financial resources determine access to neuroenhancing medication. If neuroenhancers indeed conferred advantages, wealthy groups in society would gain more such advantages. In contrast, the proponents of pharmacological neuroenhancement assert that it would help to create equal opportunities because it corrects injustice sown by distinctive biological traits. In reply, the opponents propose that this view ignores social inequalities and their root causes. The following quotation, actually phrased by supporters of neuroenhancement, illustrates the difficulties with it from the perspective of distributive justice:

> Whether the cognitive enhancement is substantially unfair may depend on its availability, and on the nature of its effects. [...] If cognitive enhancements are costly, they may become the province of the rich, adding to the educational advantages they already enjoy. [...] Policy governing the use of cognitive enhancement in competitive situations should avoid exacerbating socioeconomic inequalities [...] In developing policy for this purpose, problems of enforcement must also be considered. In spite of stringent regulation, athletes continue to use, and be caught using, banned performance-enhancing drugs. (Greely et al. 2008)

A further argument against pharmacological neuroenhancement asserts that social pressure may cause it to spread from small groups to larger groups and maybe even to the majority of the population, despite its potential risks and complications. Such a coercion phenomenon particularly applies to vulnerable groups (World Medical Association 1964/2008), such as children. Some candidate pharmacological enhancers like methylphenidate are used to treat diseases with established medical diagnoses in children, such as attention-deficit hyperactivity disorder (ADHD). Nevertheless, this therapeutic use cannot readily lead to the

conclusion that a use in healthy children for enhancement purposes is either safe or desirable. Neuropsychological studies reveal that the brain's vulnerability changes over time. Tampering with natural development without a proper medical reason may result in long-term effects that cannot be foreseen at this time.

As a vulnerable group (World Medical Association 1964/2008), children merit special attention and protection. They are not capable of informed consent, and they are subject to their parents' surrogate decisions. Schoolteachers may persuade well-meaning, but naive parents to comply with perceived social standards, thereby exerting social pressure on parents to have their children use neuroenhancers. The following citations illustrate ethical difficulties with neuroenhancement concerning children in particular:

> Behavior-modifying agents would allow parents, teachers, or others to intervene directly in a child's neurochemistry when that child behaves in a way that defies their standards of conduct. In some cases, the children clearly benefit; in other cases, they do not. In all cases, the use of such drugs to shape behavior raises serious questions concerning the liberty of children. (The President's Council on Bioethics 2003);

> Schools should be prevented from coercion [. . .] into adopting stimulants for enhancement purposes. (Singh and Kelleher 2010)

9.10 Conclusions

Neuroenhancement, as a topic in medical ethics, is worthy of careful consideration for two reasons: First, it is a specific example of enhancement, a concept that will probably be discussed even more intensely in the future, due to the fact that increasingly efficient medical systems provide an apparent excess of resources. These resources could either be utilized for enhancement purposes that benefit some, or they could improve general health standards for the general population. Second, results from neuroscientific research provide insight into the functioning of the brain and challenge human identity. Basic research results from cognitive psychology and neuromedicine are beginning to yield options for translation into medical practice.

Arguments, both those in support of and those opposed to neuroenhancement, relate to various disciplines. From a medical standpoint, several perspectives justify a critical stance, be it because of medical risks, deficits in evidence-based medicine, or challenges to health care systems. Considering society as a whole, skeptical arguments also stem from anthropology, sociology, and classical ethics, and they touch on the concepts of human nature, virtues, purposes, liberty, and justice. In conclusion, neuroenhancement should be discouraged at present.

Consequently, the specific answers posed at the beginning may be answered as follows: Pharmacological neuroenhancers should not become over-the-counter medication, and physicians should refrain from prescribing them as neuroenhancers at the present time. The pressure is on the proponents to demonstrate medical evidence for beneficial effects. In addition, they ought to present legal and financial plans for how to potentially employ neuroenhancers under certain circumstances.

Questions remain regarding how the issues of distributive justice and social coercion can be resolved and which agencies in health care systems will pay for neuroenhancement and deal with ensuing medical side effects and complications in society. On the other side, opponents need to draw attention to the numerous problems with neuroenhancement, which relate to multiple fields such as medicine, anthropology, sociology, and classical ethics. These problems defy an easy solution.

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