Neurofeedback-Based Moral Enhancement and Traditional Moral Education

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ABSTRACT

Scientific progress in recent neurofeedback research may bring about a new type of moral neuroenhancement, namely, neurofeedback-based moral enhancement; however, this has yet to be examined thoroughly. This paper presents an ethical analysis of the possibility of neurofeedback-based moral enhancement and demonstrates that this type of moral enhancement sheds new light on the moral enhancement debate. First, I survey this debate and extract the typical structural flow of its arguments. Second, by applying structure to the case of neurofeedback-based moral enhancement, I examine the ethical, legal, and social issues (ELSI) to show that this technique is unique and traditionalist, which makes it compatible with almost all our conservative notions, so that it, accordingly, can be seen as an ethically acceptable option. Third, by rejecting the premise in the moral enhancement debate that bio/neuro-enhancement has its unique ELSI that traditional methods would never create, I demonstrate that, by virtue of its traditional or conservative features, neurofeedback-based moral enhancement can be incorporated into the traditional moral education network. Finally, I conclude that, being a part of the traditional moral education network, neurofeedback-based moral enhancement can be a unique and ethically acceptable option of moral neuroenhancement.

1. Introduction

Enhancement is a sort of biotechnological intervention into the human mind and body, not aimed at curing or restoring them, but at improving them beyond their normal levels. Given its various possible influences on our society, enhancements require multiple considerations in advance for assessing the ethical, legal, and social issues (ELSI) related to them. Enhancements, in general, are classified into three types: physical, cognitive, and moral (Deutsches Referenzzentrum für Ethik in den Biowissenschaften [DRZE],

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2002; The U.S. President's Council on Bioethics, 2003), the first two of which have already become popular and have thus been regulated by laws, ethical codes, societal common sense, and/or international associations. Examples of physical enhancement technologies include cosmetic surgery and doping by top athletes (International Olympic Committee, 2014), while examples of cognitive enhancement technologies include smart drugs—off-label uses of psychopharmaceutical drugs—that both students and scientists take to obtain a desired result, such as a high score on an examination or the acceptance of research paper by a journal with a high impact factors (Buyx, 2015; Farah, 2011; Gazzaniga, 2005; Maher, 2008).

In contrast to the above, moral enhancement has yet to be realized. We have not developed any skills for *moral surgery*, nor are there pharmaceuticals, such as *moral doping* or *moral drugs*, at our disposal. Therefore, at present, the moral enhancement debate inevitably takes on a relatively philosophical and speculative, rather than empirical and demonstrative, coloration (Specker et al., 2014). However, the scientific progress of recent neurofeedback research may bring about a new type of moral neuroenhancement, namely, neurofeedback-based moral enhancement. In this paper, I conduct an ethical analysis of the possibility of neurofeedback-based moral enhancement and demonstrate that this type of moral enhancement has a unique position in the moral enhancement debate, in that it is an ethically acceptable option and has a certain affinity for traditional moral education.

2. A Premise in the Moral Enhancement Debate

Philosophical and speculative investigations lead to the great diversity of topics and arguments in the moral enhancement debate, which makes it difficult to understand this area comprehensively. Although we can find some systematic but relatively itemized reviews of the debate (Becker et al., 2017; Martin et al., 2016; Specker et al., 2014), little has been mentioned on how the moral enhancement argument is structured. To examine the feature of neurofeedback-based moral enhancement distinctly in the debate, I first survey it as clearly as possible and then extract the general structure of the argument, which consists of five steps and one premise. This section focuses on the premise, while the next section addresses the five steps.

There are two types of enhancements in general: traditional and nontraditional (Persson & Savulescu, 2012). An example of the traditional type

of moral enhancement is moral education. This is undoubtedly and legitimately labeled "traditional" because, since antiquity, moral education, in its broad sense, has covered habituation, teaching, learning, and training. It has been the most prevalent method of enhancing human morality. For example, at the beginning of Plato's dialogue *Meno*, he has Meno ask how we become moral, referring to three options: *by teaching*, *practice*, or *nature* (Plato, 1997). In Aristotle's treatise *Nicomachean Ethics* I9, referring to that passage of *Meno*, he gives five options for becoming moral (and hence happy): *by learning*, *training*, *habituation*, *God*, or *luck* (Aristotle, 1998).

In contrast, the nontraditional way of enhancement is to enhance people not by teaching, practice, or any other traditional method, but by virtue of biotechnologies. Cosmetic surgery is an example of bioenhancement where surgery is applied for enhancement; doping is an example of bioenhancement where pharmacology brings about the enhancement. More recently, the enhancement-purposive use of neuroscience, namely, *neuro*enhancement, is also concerned. As Gordijn (2015, p. 1171) puts it, neuroenhancement is 'an intervention in the central nervous system, by using pharmaceutical means, surgery, and/or technology (brain-computer interfaces or other neurotechnology), in order to "improve" certain aspects of its "healthy" or "normal" performance.' These nontraditional (bio/neuro-)enhancements seem to differ from traditional enhancements in that the methods the former adopt are different from those the latter does.

Most neuroethicists, either overtly or covertly, connect this difference with another idea that nontraditional enhancement will create unique ELSI, which traditional enhancements have never done. This can be observed when scholars suppose that traditional (moral) enhancement should be excluded from the neuroethical debate. As Schermer (2015, pp. 1179) puts it, "[n]on-technological means [...] like cognitive therapy, physical exercises, or good company, are thereby excluded from the ethical debate." A report published by the U.S. President's Council on Bioethics (2003, 6-III-B) also testifies to this when it compares "[h]uman education" with "biotechnical intervention" and suggests that it would be better if we kept to traditional methods such as moral training or self-education (see also Douglas, 2008, n. 26). In a more radical way, some have set forth the same opinion by stating that it is a misuse of the word "enhancement" to use it for referring to education and exercises (Abney & Lin, 2015).

Here, we can see a premise of the moral enhancement debate, namely that nontraditional moral enhancement will create unique ELSI, which traditional moral enhancements, such as moral education, have never created, and therefore require distinct neuroethical considerations to assess the ELSI. However, their terminology referring to "enhancement" is confusing, as it does not reflect the gap between the range that the word itself covers and which scholars denote by the word. To avoid this confusion and make the argument more concise, it would be better to use the word "*bio*enhancement" or "*neuro*enhancement" instead of "enhancement" when referring in particular to the nontraditional type of moral enhancement, except in cases where such adjectives as "neurofeedback-based" are added.

3. General Structure of Moral Neuroenhancement Arguments

Against the above premise, an argument of moral neuroenhancement can be constructed through the following five steps.

Step 1: The technological possibility. Although scholars agree that moral neuroenhancement has in no way been realized, they have different attitudes toward its future technological possibility. Some overtly assume that it will be realized in the (near) future (e.g., Douglas, 2008), while others construct their arguments without admitting to its possibility (e.g., Dubljević & Racine, 2017; Shook, 2012; Sparrow, 2014). This sort of disagreement about technological possibility would, in particular, become important if *neurogovernance*, that is, the governance of neuroscience, rather than neuroethics in the sense of the ethics of neuroscience, mattered, since neuroethical arguments cover, but are not limited to, considerations that are purely philosophical, less realistic, and occasionally sci-fi in the far-off future, whereas from a policy-making viewpoint, a distinguished argument is required, as neurogovernance that is practical rather than purely philosophical and accordingly justifies a related fiscal budget (Tachibana, 2009). However, the conflict at this step does not come to the forefront in the case of neuroethical investigations concerning the ELSI and ethical acceptability.

Step 2: Methods of intervention. The focus and character of a moral neuroenhancement argument depends partly on the possible interventions such a technique may involve, though the current discussions at this stage remain speculative. Shook (2012) proposes six options: surgical, transclinical, pharmaceutical, genetic, nanotechnic, and cybernetic interventions. Although

any of these interventions would be logically possible, many scholars regard pharmaceutical intervention as the most promising option. As the following testimonies put it, "[d]rugs to improve [...] amiability" (The U.S. President Council on Bioethics, 2003, 6-III-B), "taking-pill" and "serotonin" (Douglas, 2008), "oxytocin" (Churchland, 2011; Savulescu, et al. 2014), "oxytocin, serotonin, propranolol" (Kabasenche, 2012), "SSRIs" (Savulescu et al., 2014), and so on. This makes sense when we recall that pharmaceutical interventions such as Prozac have been a central topic in the history of the moral neuroenhancement debate (Kramer, 1993; Schermer, 2015). Furthermore, it is not irrelevant to this situation that, in cognitive neuroenhancement as well, pharmaceutical interventions such as Modafinil, Methylphenidate, and Donepezil are regarded as the most possible and promising options (Husain & Mehta, 2011; Hyman, 2011; Lynch et al., 2014; Repantis et al., 2010; Schermer, 2015; Wade et al., 2014).

Step 3: Target moral faculty. The course of argument also partly depends on which moral faculty (or faculties) moral neuroenhancement targets. For example, Douglas (2008) proposes four possible targets of human moral faculties: motives, emotions, judgments, and actions (this has been slightly changed into the following three in his (2015), namely, the human person or his character, motives, or conduct). Shook (2012) gives five different options with his assuming names of pharmaceutical products: "Sensitiva," or sensitivity to the moral features of situations; "Prudentia," or thoughtfulness; "Ethicale," or moral judgment; "Benevolium," or motivated choice; and "Prokrasia," or volitional power. Sparrow (2014) proposes that "dispositions" are another possible target faculty. Since morality is a compound concept that we have not yet been able to untangle, these remain speculative and diverse and can be controversial. The clarification of the contents in these three steps depends largely on the progress of the empirical sciences, the nucleus of which is formed by neuroscience, since these sciences play a decisive role in identifying the method, target, and technical possibility of moral neuroenhancement.

Step 4: Three ranges of ELSI. Based on the first three steps that concern the technological issues of moral neuroenhancement, the argument highlights and examines the ELSI. Schematically speaking, the ELSI of the moral neuroenhancement debate can be sorted into three different ranges: short, middle, and long (see Buyx, 2015; DRZE, 2002; Persson & Savulescu, 2012; Schermer, 2015; Shook, 2012; Sparrow, 2014; The U.S. President's Council on Bioethics, 2003). In the short range, relatively clear-focused issues are the

technical concerns that arise due to the technical conditions of a moral neuroenhancement technique, such as safety, efficacy, freedom from (or the acceptability of) adverse effects, and the degree of invasiveness. The middle range, which is relatively less clear-focused, features wider issues on the philosophical nature of human value, including personal identity, the value of effort, authenticity, the significance of naturalness, autonomy, and the meaning of happiness or a good life. These considerations may be somewhat vague because of their non-empirical character, but they are still essential for assessing the ELSI, since neuroenhancement is, above all, a technique of human transformation. The long range is the most complex, but also the widest realm; its issues are social and global one, including the value of egalitarianism or moral diversity in society, the risk of medicalization, and the solution to global warming.

Step 5: Ethical acceptability. Through these four steps plus one premise, an argument reaches the fifth and concluding step: Determining the ethical acceptability of the moral neuroenhancement technique in question. Some argue that society will accept moral neuroenhancement (Douglas, 2008; Persson & Savulescu, 2012), while others take more cynical and pessimistic attitudes toward its acceptance (Dubljević & Racine, 2017; Shook, 2012; Sparrow, 2014). Whatever attitude society takes on the technological possibility (step 1), each of their conclusions is derived in accordance with the kinds of interventions and targets they assume (steps 2 and 3), the topics they broach among various ELSI, and the types of examinations they carry out on these selected topics (steps 4 and 5).

The general structure of the moral neuroenhancement argument can be reconstructed with these five steps and one premise. For example, a negative argument can be outlined as follows: First, moral neuroenhancement is a nontraditional enhancement that requires particular neuroethical considerations (a premise). We can expect that moral neuroenhancement will be most realized in the form of a pharmaceutical neuroenhancement based on human motives (steps 1, 2, and 3). Such neuroenhancements will create several problems (step 4); for example, as a (short-range) technical issue, its invasiveness may be worrisome since, in general, an invasive procedure should be avoided or minimized by adopting the so-called invasiveness criterion and, more widely, the principle of non-maleficence (Anderson et al., 2011; Beauchamp & Childress, 2009, p. 149f.). As a (middle-range) philosophical issue, the value of effort and authenticity may be threatened, since the

pharmaceutical moral neuroenhancement of an agent's motives neither requires nor appreciates his or her effort or struggle to achieve the result and, accordingly, makes it doubtful whether the moral status acquired is authentic and trustworthy (Danish Council of Ethics, 2011; The U.S. President's Council on Bioethics, 2003). As a (long-range) social issue, it will not be compatible with moral diversity because such neuroenhancement seems unlikely to conform to different moral statuses inspired by diverse individuals' motives, since it is likely to bring about or encourage a certain uniform moral state (Sparrow, 2014). As a result of these examinations, our society is unlikely to accept such a pharmaceutical moral neuroenhancement of motives since it will not manifoldly harmonize with established social norms (Buyx, 2015) (step 5).

Actual arguments have diversity in their focus and can also reach similar conclusions with different steps. The general structure described here aims to cover as wide an area as possible and therefore is undeniably simplified. However, completing different items for each step can outline different arguments. For example, a positive argument may be structured by using "transclinical" in step 2, "actions" in step 3, and "efficacy (short-range), autonomy (middle-range), and public health (long-range)" in step 4. Sharing this general structure, it is possible to highlight the differences among the features and foci of each argument, such as the different ethical frameworks from which scholars tend to operate (see also Parens, 2006). Furthermore, as described in the next section, the distinctive features of an argument can be accentuated when a new method (S2) and target (S3) are applied.

4. Neurofeedback-Based Moral Enhancement Arguments

Neurofeedback research has been conducted with the use of electroencephalograph (EEG) (see Marzbani et al., 2016). However, recent neurofeedback research using higher spatial-resolution devices such as real-time functional magnetic resonance imaging (rtfMRI), decoded neurofeedback (DecNef), or functional connectivity-based neurofeedback (FCNef) provides a new technique that enables a subject to adjust his or her brain states using a real-time representation of brain activities (deCharms, 2008; Watanabe, Sasaki, Shibata et al., 2017; Weiskopf, 2012). During such neurofeedback training, a subject is required to control the size of a circle, flame, or whatever visually and metaphorically represents the

difference between the current and target brain states. By trial and error, a participant gradually modulates the brain activity into the target figure. The better the subject control those visual representations, the more his or her current brain state approximate the target brain state. Since each of these states is the neural representation of target human faculties such as emotions, cognition, and/or behaviors (ECB), neurofeedback training enables a subject to self-regulate his or her ECB (Tachibana 2017).

This recent research has both therapeutic and non-therapeutic aspects (Tachibana 2017). Some neuroethicists have gradually begun mentioning the possibility of neurofeedback-based cognitive or moral enhancement (Jotterand & Giordano, 2015; Scharnowski & Weiskopf, 2015; Tachibana, 2017). However, little research to date has focused on what sort of argument it will build, and accordingly, what unique ELSI it may imply, if any (Nakazawa, Yamamoto, Tachibana et al., 2016; Tachibana, 2017). Nor has it been criticized by those who oppose the very possibility of moral neuroenhancement in general (Dubljević & Racine, 2017; Shook, 2012; Sparrow, 2014). Thus, this section constructs the neurofeedback-based moral enhancement argument, considers the ELSI, and examines its implications, taking the aforementioned five steps and comparing them with the other existing options.

Premise. First, let us share the premise that most neuroethicists assume, overtly or covertly, that neurofeedback-based moral enhancement is a nontraditional enhancement and therefore requires particular neuroethical considerations.

Step 1. As for the technological possibility of neurofeedback-based moral enhancement, a relatively positive and optimistic attitude can be taken because this technique has already been conducted with the general population as well as people with disorders and succeeded in changing their ECB, or core factors of human morality. Touching an aspect of human morality, neurofeedback techniques may be a tool for moral enhancement in the near future, even if they initially start with only a limited application. Although there may be moral factors other than ECB with which this technique does not deal at present, such as what Aristotle calls *proairesis* (approximately, decision or choice) or what Kant calls *die praktische Vernunft* (practical reason) (Aristotle, 1998; Kant, 1788), neurofeedback-based training may even be able to modulate these factors if they are reduced

to more primitive factors, or if their neural correlates are found (Hughes, 2015).

Step 2. Neurofeedback-based moral enhancement using fMRI and/or EEG only decodes brain information. This option has yet to be presented in any expected method of intervention.

Step 3. Neurofeedback-based moral enhancement can target ECB. Since the target brain state can be set flexibly at the region-of-interest or voxel level, the training can be personalized (Scharnowski & Weiskopf, 2015; Tachibana, 2017).

Step 4. In accordance with the method of intervention and target moral faculties, three-range ELSI emerges. For example, the ELSI includes, but is not limited to, the following three major issues. (Some other issues will be investigated in Section 6.)

Step 4a/short-range: Safety. As a technical issue, safety should be considered above all other factors, although it has received relatively little attention in the moral bioenhancement debate (Specker et al., 2014). Neurofeedback-based moral enhancement uses only fMRI, which is well-known for its lower number of adverse effects than pharmaceutical interventions (Shellock & Crues, 2004; Weiskopf, 2012). The safety aspects of this intervention are evident: drug-free, non-maleficence, noninvasiveness, and fewer adverse effects (Scharnowski & Weiskopf, 2015; Tachibana, 2017). This feature shows a clear advantage over not only pharmaceutical approaches, but also the other possible interventions, such as deep brain stimulation (DBS), which is a well-known therapeutic technique for movement and, recently, neuropsychiatric disorders (Chapin et al., 2012; Pacholczyk, 2015; Suthana & Fried, 2014) and transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS), which are occasionally considered noninvasive techniques (Cohen Kadosh et al., 2012; Luber, 2014; Steven & Pascual-Leone, 2006). While they still compulsorily change neural activities in a subject's brain and can result in adverse events (Walter et al., 2001), fMRI causes nothing in a subject's brain without his/her voluntary activity.

Step 4b/middle-range: Non-cheating, value of effort and authenticity. Existing enhancement techniques such as doping and smart drugs are blamed for cheating. These bioenhancements are said to be cheating, not because they violate fairness, for such bioenhancements would ensure fairness by adjusting the rules of athletics or exams to suit the aims of these

activities, but because those who use such bioenhancements do not dedicate specific effort to achieve the results, and accordingly, are not authentic (Schermer, 2008). In contrast, neurofeedback-based moral enhancement can avoid this criticism because it requires the participant's effort in his or her neurofeedback trials. Different from, for example, pharmaceutical or DBS-based neuroenhancements, nothing changes in the brain without the subject's spontaneous and active effort (Focquaert & Schermer, 2015). Experiencing trial and error, a participant gradually modulates the brain activity into the target figure, and finally achieves the target brain state. This effort is similar to our daily non-cheating activities such as housework, a drill in/after school, and basic physical trainings. Their achievement is non-cheating because it is the result of daily repeated efforts and is accordingly authentic, even if we do not fully understand the significance of these routine tasks during the course of our training. For the same reasons, neurofeedback-based moral enhancement is not cheating and therefore retains the value of effort and yields authentic results.

Step 4c/long-range: Moral diversity. Regarding social and global issues, the problem of moral diversity requires consideration above all else, since those who take a cynical or negative attitude toward the possibility of moral neuroenhancement identify this problem as one of the major reasons for their attitude (Shook, 2012; Sparrow, 2014). Pharmaceutical and surgical neuroenhancements are likely to bring a certain uniform moral state and, accordingly, will not save moral diversity, since such neuroenhancements make it difficult to realize the different moral states aspired to by various individuals (Nakazawa, Yamamoto, Tachibana et al., 2016). In contrast, neurofeedback-based moral enhancement can theoretically avoid this problem because, by virtue of its variety of target moral faculties and its highly personalized procedure, a single device is thought to be available for realizing various different moral states to different individuals without adopting any specific moral theory (Tachibana, 2017).

Step 5. Handling the various considerations that appear in the four-step examinations, neurofeedback-based moral enhancement shows its various powerful advantages among the possible options of moral neuroenhancement and, accordingly, can be declared an ethically acceptable option for moral neuroenhancement. In the next section, comparing neurofeedback-based moral enhancement with traditional moral education,

I demonstrate that this option has a further ethical acceptability for moral neuroenhancement.

5. Neurofeedback-Based Moral Enhancement as a Part of Traditional Moral Education

Based on its features in ELSI and ethical acceptability, neurofeedback-based moral enhancement casts doubt on the premise presupposed in the moral bioenhancement debate that was formulated in Section 2. The dichotomy between traditional and nontraditional methods in enhancement is *per se* conceptually correct because the line can be drawn clearly by appealing to historical facts. However, it is dubious to assume that the dichotomy corresponds to the presence or absence of neuroethically unique ELSI. This doubt will be ascertained to be true by comparing the features of neurofeedback-based moral enhancement explicated in Section 4 with those of traditional moral education. As for the method of intervention, traditional moral education takes a noninvasive and oral approach to teaching (except in the case of violence, such as corporal punishment). As for the target moral faculties, it can set them flexibly, but it is (considered) effective: A teacher can scold his or her pupils for displaying an undesirable emotion, making an irrational judgment, and/or displaying aggressive behavior. As for ELSI, it is safe (noninvasive, physically safe, and drug-free), appreciates the value of effort, invests in authenticity, and is compatible with moral diversity. This comparison confirms that there is no ethically significant difference between traditional moral education and neurofeedback-based moral enhancement (Table 1). Neurofeedback-based moral enhancement can be traditional in this sense. By virtue of its traditional or conservative character, the distinction between traditional moral enhancement and neurofeedback-based moral enhancement is a distinction without a difference. As a matter of course, they have many differences, such as the tools they use and the places where they are conducted. However, such differences would be too peripheral to entail any unique neuroethical consideration. This means that neurofeedback-based moral enhancement does not fall under the premise in the moral enhancement debate and, accordingly, that neurofeedback-based moral enhancement may not have enough unique ELSI to make it different from traditional moral education.

	Traditional moral education	Neurofeedback-based moral enhancement
Step 2: Methods of intervention	noninvasive	noninvasive
Step 3: Targeted moral faculties	flexible, but effective	flexible, but effective
Step 4a: Safety	physically safe, drug-free	physically safe, drug-free
Step 4b: Value of effort / Authenticity	appreciates	appreciates
Step 4c: Moral diversity	compatible	compatible

Table 1. A comparison between traditional moral education and neurofeedback-based moral enhancement

This very fact sheds new light on the relationship between neuroenhancement and traditional education. The relationship between neuroscience, neuroenhancement, and traditional education *per se* has been discussed in a multifaceted way. For example, neuroscience has been expected to uncover the neural mechanism of human learning, provide diagnostic criteria of developmental disorders, reinforce current educational practices mainly in schools and classrooms, and clear up so-called "neuromyths" (Ansari, 2015; Goswami, 2006; Kalbfleisch, 2012; Organization for Economic Cooperation and Development, 2002; Organization for Economic Cooperation and Development, 2007; Sheridan et al., 2006). Others argue that education is one of the most likely domains to which neuroenhancement applies (Christen & Narvaez, 2012; Specker & Schermer, 2017). Still others identify neuroenhancement with education (see Pascual-Leone et al., 1998; Steven & Pascual-Leone, 2006).

By contrast, the argument presented in this paper is not intended to support any of these thoughts. Rather, it aims to propose a different relationship between neuroenhancement and education, namely, the idea that neurofeedback-based moral enhancement could work peacefully as part of the traditional moral education network. Looking back on our youth, we remember that so-called moral education happened everywhere in our daily lives, not only with our parents at home and teachers at school, but also in the community where we grew up, among our friends who stood by us after school hours, the partner(s)

whom we loved or who loved us, and the novels and movies we were impressed with. Each of these influenced our moral development and aided the establishment of our sense of values and way of living. Such scenes of moral educational happen even among adults: "A slave to lust" converted to Christianity in the New Testament (Augustine, 1840, 6.15.25); an automobile recall specialist changed his way of living when he met the Fight Club (Palahniuk, 1996); and we may serendipitously encounter thousands of self-help books that allegedly work their life-changing magic on us. Our sense of values and moral character have developed with these and other affairs from childhood to the present: As Aristotle puts it, moral education is a lifelong activity (Aristotle, 1998, X9, 1180a1-4). In the course of such education, some engage intentionally, while others do not, some are reliable, but others dubious. Still, we allow these practices to influence our moral development; in other words, they work as parts of our moral education. Following a parity principle that states "[u]nless we can identify ethically relevant differences between internal and external interventions and alterations, we ought to treat them on a par" (Levy, 2007, p. 62), there is no obstacle here to adding neurofeedback-based moral enhancement to this amalgam of these scenes of moral education, given that there is no serious difference between traditional moral education and neurofeedback-based moral enhancement. By virtue of its traditional character, neurofeedback-based moral enhancement could form a part of a traditional moral education network, just as friends, movies, religions, clubs, and self-help books do.

6. Further Possible ELSI

Further possible ELSI need to be considered to assess this relationship. Insofar as ethical acceptability is not equal to social feasibility, some ethically acceptable issues may impede the social acceptance of this technique. However, I reckon that the traditional character of neurofeedback-based moral enhancement would also dissolve other ELSI and, accordingly, strengthen its ethical acceptability. I give a further three ELSI that will suggest the way in which neurofeedback-based moral enhancement could be incorporated into the traditional moral education system. I then show that none of them would be burdens on neurofeedback-based moral enhancement, or at least no more so than on traditional moral education, because the former is part of the latter.

1. Irreversibility. We appreciate the value of freedom in our way of living—including the freedom to alter ourselves again later, to some extent. Pharmaceutical moral enhancement saves this value, since it will be reverted by virtue of our metabolic system (except for addiction). In contrast, if the alterations of neural networks induced by neurofeedback-based moral enhancement were not reversible or were hard to reverse, then this technique would threaten that freedom (Nakazawa, Yamamoto, Tachibana et al., 2016). However, recent studies report that it has a certain reversibility: The effects are observed 2–5 months after from 4–8 hours to 3–4 days neurofeedback training (Amano et al., 2016; Fukuda et al., 2015; Weiskopf, 2012). Furthermore, it is noteworthy that even traditional moral education may not have enough irreversibility, especially in juvenile education (Kabasenche, 2016). Ancestral wisdom also testifies to this with maxims such as "what is learned in the cradle is carried to the grave"; "the child is father of the man"; and "as the twig is bent, so grows the tree." Although further research is needed, indications are that the current longevity of the effect of neurofeedback training would bring no more unfavorable irreversibility to its social implementation than traditional moral education does.

2. Adverse effects. Although fMRI is a highly safe tool for neuroimaging, as discussed in Section 2, observations of long-term prognoses are required, since the adverse effects of neurofeedback training have been reported twice in therapeutic research (The U.S. Food and Drug Administration, 2012; Ruiz et al., 2013). Given that morality and normativity do not consist of stand-alone facets, but of holistic factors, one factor being altered artificially may unintentionally affect the state of another factor. Accordingly, successful therapy with neurofeedback training might make a patient's social balance worse if his original mental disorder were adaptive to his social environment (cf., Kabasenche, 2012). This means that neurofeedback training on morality may cause an unpredictable and undesirable adverse effect, such as depression, even if it successfully enhances the target moral aspect, such as compassion.

This problem is, however, not specific to neurofeedback training, but true of nontraditional enhancement in general and even traditional enhancement. As for nontraditional cases, enhancing a woman's facial tissue with cosmetic surgery may also change her character: She may become more social, cheerful, and confident. However, she may simultaneously become more arrogant and/or dysmorphic. For the worse, she may contract, aggravate, or suppress an obsessive–compulsive disorder, such as body dysmorphic disorder. A man who

builds his muscles with doping might become more confident, but also more violent. A college student who takes a smart drug may become more focused, but nastier. As for the cases of traditional enhancement, gymnastic activities make a stout physique, but might make someone a brute. Intellectual education makes students intelligent, but some might become depressive as well. Whatever the method may be, whether traditional education or nontraditional neuroenhancement, some unintentional and adverse effects such as arrogance, brutality, nastiness, or even mental disorder may appear. Although these effects may occur both directly and indirectly, they are all adverse. Thus, the genuine problem of adverse effects in the moral enhancement debate is not to distinguish nontraditional and traditional enhancement, but to comprehend the holistic structure of human morality and establish a way of avoiding the risk of each adverse effect. To deal with this problem, further research is required on the neural correlates of various moral factors and their interactions with large, empirical, and phenomenal data. This research should be undertaken concerning how human moral factors influence and integrate with each other at the phenomenal level from primitive moral factors, such as compassion and kindness, to higher-order moral attitudes, such as those toward gun control, abortion, or climate change (see, for example, Handfield et al., 2016; Kleiman-Weiner et al., 2017). When it comes to this stage of the problem, we will not be presented with two choices between traditional moral education and neurofeedback-based moral enhancement.

3. Moral relativism. As discussed in Section 4, the personalized procedure of neurofeedback-based moral enhancement makes it possible to avoid moral uniformity and preserve moral diversity. However, in contrast, the very feature of this might intensify the differences of people and finally lead to moral relativism. A man of deontic temptation will not want to become utilitarian, but more deontic and vice-versa. People are inclined to enhance what they spontaneously appreciate. Since this technique can help people realize anything they want, it may influence them to become increasingly different from each other (Tachibana, 2017; see also Gyngell & Easteal, 2015). If this brings about moral relativism, then neurofeedback-based moral bioenhancement may not be ethically so acceptable.

We can deal with this problem by incorporating neurofeedback training into traditional moral education networks, since the network does avoid moral relativism. Roughly speaking, human moral normativity has a gradation of generality from universal to personal that can be schematically classified into five

levels: (1) universal morals, such as human rights and the law-abiding spirit that should be appreciated by everyone, regardless of whatever moral theory he/she is committed to; (2) society-laden morals, such as attitudes toward seniors that are different in societies, for example, between the U.S. and Japan; (3) local community-laden morals, such as interpersonal distances that can be observed, for example, between Tokyo and Kyoto; (4) family-laden morals, such as family precepts that should be different, for example, between the home of the current prime minister of Japan and that of mine; and (5) personal morals, such as one's way of living that can be different, for example, between my brother and me. Each level does not provide the full definition of morality, but rather reflects an aspect of our understanding of morality. The traditional educational system fits with this multifaceted conception of morality by covering both public education (in other words, citizenship education) and private education (not private schooling) (see Tachibana, 2008). The first three levels of morality are cultivated and evaluated in public, whereas the last two levels are cultivated in private. This system brings not only moral diversity, but also rejects moral relativism. Incorporated into this system, neurofeedback-based moral enhancement can avoid the risk of moral relativism because, whatever level it will be used in, the traditional educational system deals with this problem as it is used to doing so.

7. Conclusions

This paper has demonstrated that neurofeedback-based moral enhancement can be an ethically acceptable option for moral neuroenhancement by virtue of its traditional character. It does not infringe on existing ethical and social norms, but shares core features with traditional moral education. Eroding the dichotomy between traditional and nontraditional methods in enhancements presupposed in the moral bioenhancement debate, it can disarm the obstacles for it to work as a part of the traditional moral education network. This incorporation strengthens its ethical acceptability.

There is no doubt that circumspection should be appreciated to avoid an agitative and delusive argument insofar as its mechanism remains uncertain (Shook & Giordano, 2016). Simultaneously, however, ELSI should be considered in advance and forewarned if necessary, since such issues will have a large influence on our life and society. The traditional character of neurofeedback-based moral enhancement bestows not only the ethical

acceptability with this technique, but also may bring a seamless moral education network in which neurofeedback training is incorporated. If its traditionality and ethical acceptability may soften people's wariness towards this technique and accordingly accelerate its social implementation, ELSI of neurofeedback-based moral enhancement need to be investigated before such implementation.

From this viewpoint, there is a genuine issue that should be handled beforehand, namely, a need for ethics of the nontherapeutic use of neurofeedback techniques with minors. To date, the focus of the ethics of neuroenhancement with minors has been on pharmaceuticals (Singh & Kelleher, 2010) and non-invasive brain stimulations, such as TMS and tDCS (Cohen Kadosh et al., 2012; Maslen et al., 2014), rather than neurofeedback techniques. However, recently, it appears that a few nontherapeutic neurofeedback studies focused on minors, including an rtfMRI-based emotion regulation study with a group of 17 7–16-year-olds (Cohen Kadosh et al., 2016). Ethics regarding the neuroenhancement of minors should cover not only brain stimulation techniques or pharmaceuticals, but also neurofeedback techniques, by considering related issues such as unpublished clinical data (Walter, 2001) and the uniqueness of neuroenhancement research (Kelly & Ford, 2015). Given that neurofeedback-based psychotherapy has already become a medical service covered or reimbursed by health insurance in some countries such as the U.S., a wider governmental guideline and policy should also be considered (see also Plischke et al., 2011). While continuing rigorous neurofeedback research to withstand intensive criticism, we should bestow various neuroethical considerations on neurofeedback-based moral enhancements.

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