

# Frequently overlooked realistic moral bioenhancement interventions

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## ABSTRACT

Many supporters of 'moral bioenhancement' (MBE), the use of biomedical interventions for moral improvement, have been criticised for having unrealistic proposals. The interventions they suggest have often been called infeasible and their implementation plans vague or unethical. I dispute these criticisms by showing that various interventions to implement MBE are practically and ethically feasible enough to warrant serious consideration. Such interventions include transcranial direct current stimulation over the medial and dorsolateral prefrontal cortex, as well as supplementation with lithium and omega-3. Considering their efficacy and feasibility, it is strange that these interventions have rarely been proposed or discussed as MBE. I review evidence that each of those interventions can reduce antisocial behaviour, reduce racial bias, increase executive function or increase prosocial traits like fairness and altruism. I then specify and defend realistic, ethically permissible ways to implement these interventions, especially for violent offenders and public servants—the former as rehabilitation and the latter to meet the high standards of their occupations. These interventions could be given to violent offenders in exchange for a reduced sentence or compulsorily in some cases. Potential intervention methods for non-prisoners include increasing the USDA-recommended dose of omega-3, encouraging food companies to supplement their products with omega-3 or trace lithium, requiring MBE for employment as a police officer or political leader, and insurance companies providing discounts for undergoing MBE. In some reasonably limited form, using these interventions may be a good first step to implement the project of MBE.

Since its introduction in 2008, the concept of moral bioenhancement (MBE) has generated a wide-ranging discussion in the academic bioethics literature. Broadly construed, MBE is the use of biomedical interventions for moral improvement.<sup>1</sup> For example, Douglas<sup>2</sup> suggested that a biomedical intervention which reduces emotions that predispose people to antisocial behaviour or racial bias should at least be morally permissible. Murray,<sup>3</sup> however, claimed that the idea of MBE 'completely undermines our understanding of moral goodness' by basing it in biology rather than free choice. Whenever authors generalise about whether MBE should be implemented without specifying which interventions or implementations they mean, though, they confuse the discourse because proposed ways to implement MBE interventions vary widely in practical and ethical feasibility.<sup>1</sup> Using what Wiseman<sup>1</sup> called a 'practical-realities first' approach (p13), I will evaluate the feasibility

of several MBE interventions that could be implemented with current technology.

Since I focus on the feasibility of implementing various interventions, discussing why a particular trait should or should not be modulated is outside the scope of this paper. I assume that any intervention that safely, reliably and effectively causes moral improvement is a moral enhancement. I also assume (somewhat like Douglas<sup>2</sup>) that reducing racial bias or antisocial behaviour is a moral improvement, all else being equal and (like Persson and Savulescu<sup>4,5</sup>) that so is increasing prosocial behaviour, cognitive empathy (ie, 'theory of mind'), sympathetic concern for others' well-being, fairness or executive function. By 'executive function' I mean self-control, will-power, cognitive flexibility and working memory. Many critics of MBE will not grant these assumptions. Without sufficiently similar ones, many of my conclusions will not follow. Yet, for each of those traits, some MBE proponents have said to alter it as MBE. Those proponents' support for claims similar to my assumptions makes them plausible enough to use for exploring the practical and ethical feasibility of implementing various interventions.

## COMMONLY PROPOSED MBE INTERVENTIONS

Interventions commonly considered for MBE are usually pharmaceuticals, brain stimulation or genetic engineering. Pharmaceuticals are usually intended to alter neurotransmitter concentrations, while brain stimulation devices usually apply either an electrical current or a magnetic field to the brain to alter its neuronal electrical activity.<sup>1,6,7</sup> Many different pharmaceuticals have been proposed for MBE, including oxytocin to enhance cognitive empathy and sympathetic concern,<sup>4,5</sup> selective serotonin reuptake inhibitors (SSRIs) to reduce impulsive violence, propranolol to reduce implicit racial bias,<sup>1,5,6</sup> 3,4-methylenedioxymethamphetamine (MDMA, or 'ecstasy') to enhance positive and prosocial emotions and testosterone reduction to reduce aggression.<sup>2,7</sup>

Neurostimulation technologies proposed for MBE include transcranial magnetic stimulation (TMS), deep-brain stimulation (DBS) and transcranial direct current stimulation (tDCS). TMS induces a dynamic magnetic field around a specific brain region(s) to alter its neuroelectric activity. Since TMS is non-invasive, it usually only affects regions near the surface of the brain. In contrast, DBS devices are electrodes surgically implanted into deeper regions of the brain. The electrodes emit regular electric impulses to activate surrounding neurons.<sup>7</sup> tDCS runs a low-level electric current through brain regions by placing pairs of electrodes



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on the scalp to change neuron excitability in the brain regions underneath. The current in each pair flows from the cathode to the anode, making neurons under the cathode less likely to fire and those under the anode more likely to fire.<sup>8</sup>

While the initial findings about these various medicines and neurotechnologies have sparked hope among supporters of the MBE project, all of the interventions named in the previous two paragraphs have been criticised as infeasible. In their brief review of the literature, Dubljević and Racine<sup>7</sup> called most of them ineffective and sometimes even counterproductive. They dismissed using SSRIs, beta-blockers like propranolol, testosterone reduction drugs, MDMA and DBS because of those interventions' allegedly unclear effectiveness as MBE. They also criticised MBE based on TMS and tDCS for apparently counterproductive effects on participants' moral reasoning.

Their dismissal of tDCS shows several key misunderstandings, although I will not dispute their criticisms of other potential MBE interventions here. When examined more closely, the evidence they reviewed actually supports using tDCS for MBE. The other relevant problem with their analysis is its scope. The number of interventions they reviewed is admirable, but they ignored several that have largely passed under the radar of the MBE debate despite showing greater safety, efficacy, convenience and evidential support than those most commonly discussed. Specifically, Dubljević and Racine<sup>7</sup> did not address the feasibility of using omega-3 and lithium supplements for MBE. Preliminary evidence suggests that both supplements—as well as tDCS over the prefrontal cortex (PFC)—are safe, effective and feasible enough to warrant further research and to be seriously considered as methods to implement MBE.

### PREFRONTAL CORTEX TDCS

Unlike DBS, tDCS does not require invasive brain surgery. Unlike TMS, it does not require a bulky and expensive machine. Both factors make tDCS extremely convenient to acquire and use. However, the literature on its cognitive effects is mixed. Several meta-analyses and systematic reviews that I will summarise examined the effect of tDCS over the dorsolateral prefrontal cortex (DLPFC) on executive function. Even within those specific parameters, they found inconsistent results. Still, the available evidence suggests that anodal DLPFC tDCS has a small beneficial effect on executive function.

Horvath *et al*<sup>9</sup> reviewed 271 tDCS studies, 62 of which tested working memory and 28 tested other forms of executive function. They found that all of the beneficial cognitive effects cancelled out with an average effect size of zero. However, Chhatbar and Feng<sup>10</sup> criticised their analysis for only considering between-group effects, among other reasons. Horvath *et al*<sup>9</sup> only compared working memory task performance between the tDCS and the sham stimulation groups, without examining whether task performance after stimulation improved on performance beforehand in the tDCS group. Accounting for this problem, Dedoncker *et al*<sup>11</sup> reviewed 61 studies of DLPFC tDCS that reported within-subject effects. Anodal, but not cathodal, DLPFC stimulation reliably reduced healthy participants' reaction times and increased neuropsychiatric patients' accuracy on cognitive tasks.

Cathodal tDCS significantly reduced executive function in a review of 37 tDCS studies, while anodal tDCS significantly increased it by an average effect size of +0.9.<sup>12</sup> A meta-analysis of 16 studies also found beneficial effects of anodal DLPFC tDCS on reaction times and accuracy, although some effects did not reach statistical significance and many had low effect

sizes. Longer and more powerful stimulation caused stronger effects, though, providing a potential explanation for the mixed evidence of tDCS benefits: insufficient stimulation.<sup>13</sup>

DLPFC tDCS is relevant to MBE primarily because it enhances executive function, but it may have other benefits. Choy *et al*<sup>14</sup> recently examined the effects of single-session anodal DLPFC tDCS on participants' self-reported likelihood of committing physical and sexual assault. Stimulation reduced participants' intention to commit physical assault by 47% and sexual assault by 70%, showing that DLPFC tDCS can not only improve executive function but can also improve intentions. Perhaps that is why bilateral anodal DLPFC tDCS significantly reduced self-reported aggression on all dimensions of the Buss-Perry Aggression Questionnaire in a sample of imprisoned murderers.<sup>15</sup>

Dubljević and Racine<sup>7</sup> rejected tDCS of the DLPFC as an MBE intervention because it made participants less likely to reject unfair offers in one study. But that study only applied cathodal stimulation, noting that cathodal tDCS reduces—and anodal tDCS increases—neuroelectric activity.<sup>8</sup> If cathodal DLPFC tDCS reduces fairness, then maybe *anodal* DLPFC tDCS will *increase* fairness—which it does. Participants given *cathodal* DLPFC tDCS distribute incomes *less* fairly than controls behind a Rawlsian 'veil of ignorance'. Yet, those given *anodal* DLPFC tDCS distribute incomes *more* fairly, possibly because cathodal stimulation increases impulsivity and anodal stimulation reduces it.<sup>16</sup> Dubljević and Racine then only strengthened the case for using anodal DLPFC tDCS as MBE.

Activating the ventromedial prefrontal cortex (vmPFC) using anodal tDCS has increased participants' altruism and trustworthiness in economic games,<sup>17</sup> contradicting the claim by Dubljević and Racine<sup>7</sup> that vmPFC tDCS 'interventions seem to promote selfish behaviour instead of moral conduct' (p347). Anodal mPFC tDCS has reduced implicit prejudice against out-groups,<sup>18</sup> suggesting its potential for MBE to reduce implicit racial bias. It has also increased costly prosocial behaviour. When participants were asked to pay their own money in return for a specific likelihood of preventing others from experiencing a painful electric shock, anodal mPFC tDCS made them more likely to sacrifice their money given a high probability of preventing others' pain.<sup>19</sup> Anodal tDCS over the dorsomedial PFC has increased cognitive empathy in several studies.<sup>20 21</sup> All of these studies and similar examples in the literature<sup>22</sup> show promise for using anodal (v)mPFC tDCS as MBE.

Dubljević and Racine rejected vmPFC tDCS because in one study, it increased frequency and decreased reaction times of utilitarian responses in trolley-problem-like moral dilemmas, as psychopaths have been shown to. Yet, in that study, stimulation only increased utilitarian responses among females, and cathodal but not anodal tDCS decreased reaction times of utilitarian responses.<sup>23</sup> Utilitarian responses without shorter reaction times may only show more thought put into the decision rather than psychopathic tendencies. The drawbacks of anodal (v)mPFC tDCS are less serious than Dubljević and Racine portrayed, suggesting that the benefits might outweigh the drawbacks. However, less research exists on it than on DLPFC tDCS, so more research would be needed before implementation.<sup>22</sup>

### LITHIUM AND OMEGA-3 SUPPLEMENTATION

Lithium supplementation and medication also show promise as effective MBE interventions. However, lithium has rarely been described as MBE. Only a few authors have acknowledged its potential. Those who did have usually only mentioned offhand that it can reduce impulsive aggression, as Wiseman<sup>1</sup> did in a

footnote (p294). Only Earp *et al*<sup>6</sup> mentioned lithium as MBE of self-control, even though as they pointed out, it has better ecological validity than most of the aforementioned interventions.

Lithium medication has been known to reduce aggression for 70 years—an effect shown in various populations, including aggressive children and adolescents, the elderly, the mentally disabled and especially in aggressive prisoners.<sup>24</sup> Trace amounts of natural lithium in drinking water have been linked to fewer incidents of homicide, suicide and rape in several studies cross-culturally.<sup>25</sup> Lithium reduces aggression not merely by stabilising mood, but by increasing inhibitory control of aggressive impulses.<sup>26</sup> From these findings, Goldstein and Mascitelli<sup>25</sup> hypothesised that violence is partly just a symptom of lithium deficiency.

Fish oil supplements could also be used for MBE since Raine<sup>27</sup> reviewed various studies showing that omega-3 fatty acids reduce aggression (pp294–297, 441–442). High omega-3 levels have been repeatedly found to predict lower levels of aggression, among adults in general<sup>28</sup> and prisoners specifically.<sup>29</sup> Moving beyond correlational research into a setting highly relevant to applying MBE, omega-3 supplementation programmes have significantly reduced young adults' in-prison violence by over 33% in two randomised controlled trials in prisons.<sup>30 31</sup> Note that studying interventions' effects on actual violence in criminal populations addresses Wiseman's<sup>1</sup> critique that MBE proponents too often rely only on laboratory-controlled research divorced from difficult real-life moral decision-making (pp115–121). Raine<sup>27</sup> also reviewed seven experiments in Australia, Italy, Japan, Sweden, Thailand and the USA, which reduced adults' aggression using omega-3 supplements by as much as 42.7% (pp296, 442).

Like lithium, omega-3 supplementation is rarely discussed in the MBE literature. Few authors have explicitly named it as a potential MBE intervention, and only as an offhand example of a strategy to reduce aggression by improving impulse control.<sup>6</sup> Using lithium and omega-3 for MBE interventions should be explored further.

### LITHIUM FOR VIOLENT OFFENDERS AS MBE

The benefits of having higher trace lithium levels in the water supply raise the question of whether the public water supply should be intentionally supplemented with trace lithium, like how many American cities fluoridate tap water. However, public water is often used for purposes other than consumption. Goldstein and Mascitelli<sup>25</sup> suggested fortifying grain foods with trace lithium to waste less of it. They still suggested improving behaviour through biomedical treatment to increase self-control, though, so they recommended MBE. Using lithium medication in therapeutic doses to reduce aggression in specific populations is another possible lithium MBE intervention.

Wiseman<sup>32</sup> called the idea of supplementing tap water as MBE 'completely unworkable and undesirable' (p48) because it is compulsory and indiscriminate but those concerns can both be resolved by using lithium supplementation in targeted populations. Since violent offenders especially show the impulsive aggression reduced by lithium supplements, lithium supplementation for violent offenders is a discriminate treatment. And since imprisonment is coercive, one cannot reject compulsory MBE of violent offenders only because it is coercive without also rejecting the idea of prison.

One could also object to compulsory MBE of violent offenders based on the need to protect their bodies from intentional interference by others. However, Douglas<sup>33</sup> showed that almost any

argument for protecting this right of violent offenders extends to protecting their freedom of movement and association, which imprisonment already violates. Barn<sup>34</sup> replied that criminals' bodily integrity is indeed analogous to those freedoms because *neither* should be violated on rehabilitative grounds. Yet, even if imprisonment is unjustifiable, rehabilitation including MBE may be a *better alternative* to prison. Against this, Barn gave four objections: (1) one must first show that rehabilitative MBE works, (2) rehabilitation should focus on the social and not the biological causes of crime, (3) MBE cannot replace prison because not all crimes are immoral and (4) the social stigma from MBE might make it too harmful to justify.<sup>34</sup>

To (1), I already gave evidence of plausibly feasible MBE interventions, which could supplement a rehabilitation programme. To (2), why not both? Many biological factors influence one's tendency to commit violent crimes. Due to synergistic interaction effects, the most effective way to rehabilitate violent criminals is to address social *and* biological factors.<sup>27</sup> To (3), I focused specifically on violent criminals—including murderers and rapists—because calling almost all violent crimes immoral is so uncontroversial. Rehabilitative MBE may not prevent many amoral crimes, but other methods could address those if necessary. Finally, Barn's fourth objection rightly raised concern over the social stigma of MBE but failed to consider the massive social stigma already carried by criminals. It is unclear how criminals' social stigma would change after replacing some functions of prison with rehabilitation that includes MBE. It may even be hypocritical of Barn to ask for evidence in her first objection while speculating about stigma in her fourth.

Barn also gave two attempts at *reductio ad absurdum*, which were not very absurd. She claimed that two unusual punishments for criminals—making them relive their crimes from the victim's perspective or making them sleep for half of the day—are justified under Douglas's reasoning as long as they do not involve more suffering and coercion than Douglas's idea of 'minimal incarceration', so that reasoning must be mistaken. But by Barn's admission, even those punishments inflict minimal suffering and coercion—less than most prisoners already experience.<sup>34</sup> No intervention I recommend for mandatory MBE is invasive (puncturing the body) or likely to harm recipients by reducing their health or capabilities at the doses I recommend. Even if one endorses mandating those interventions for violent prisoners, one need not endorse mandating those that Barn mentioned, which are more invasive or less beneficial. So the right to bodily integrity may not always justify objecting to mandatory MBE for violent criminals, especially using the safe and non-invasive interventions I described.

Admittedly, therapeutic doses of lithium have significant adverse side effects. They include a subjective experience of 'mental slowing' alongside mild impairments in verbal memory, psychomotor speed and creativity that are less severe at low doses.<sup>35</sup> Yet, in *trace* amounts (<200 µg/L), lithium is not toxic.<sup>25</sup> Adverse effects are then no concern to compulsory supplementation with trace lithium. Since treatments with a high risk of adverse effects should only be applied to patients who have given informed consent, therapeutic doses of lithium should only be used for voluntary MBE. For example, a violent offender could choose therapeutic lithium treatment in exchange for a reduced sentence. Any critics of the prison system who view it as unnecessarily cruel should call reduced sentences an especially helpful incentive since it frees prisoners sooner. Still, if offering reduced sentences is too coercive, therapeutic lithium treatment could be used with a different incentive or no incentive.



Omega-3 supplementation and anodal PFC tDCS could be implemented similar to lithium, although with less concern about adverse effects. They could justifiably be mandatory, or offered in exchange for a reduced prison sentence, for the same reasons. All three are benign and feasible as MBE.

### THE POLITICAL FEASIBILITY OF MBE

Moving on from MBE of prisoners, perhaps the USDA could increase its recommended daily amount of omega-3 intake to whatever safe dose is optimal for reducing antisocial behaviour as a form of MBE. Although indiscriminate, it would be justifiable because it is safe and voluntary. Encouraging various food companies to supplement their products with trace lithium, as some beverages like 7-Up did during the 20th century, would likewise be justifiable.

Another justifiable discriminate use of MBE is for government officials, especially police officers and political leaders. As public servants, both are already held to a higher moral standard than the general population. They are all expected to set aside personal gain and act primarily for the benefit of their communities, even at great personal sacrifice. Their occupations usually require high prosociality and self-control for making difficult moral decisions with significant ramifications for others' welfare. The fact that they often fail to meet these high standards only makes it more critical for them to undergo MBE. For example, any training programme to reduce police officers' implicit racial bias is non-biomedical moral enhancement. If some MBE interventions are ethical and effective enough to do the same, or at least complement that kind of training, then they should be implemented for MBE of the police. MBE for public servants could justifiably be mandatory for a different reason than for violent offenders. Since public service is almost always a voluntary job that one can quit at any time, anyone uncomfortable with MBE could avoid it by not choosing a job that requires MBE.

Considering how many evils come from the orders of some political leader(s), perhaps the best possible use of MBE would be to enhance political leaders. Power corrupts, as most people know, by reducing morally good traits. So perhaps MBE of those traits could be required for some political leaders to protect against power's corrupting influence, helping to solve that fundamental problem of politics. However, while MBE of violent offenders or police officers could be mandated by their supervisors, the leaders who most need MBE have no supervisors. Few could coerce or incentivise a leader to undergo MBE. In the unlikely possibility that MBE gains public support, a democracy's public could pressure its leaders to undergo MBE. But that is not realistic enough to seriously recommend anytime soon.

Perhaps the most practical objection to MBE, which disputes neither the effectiveness nor the moral goodness of any intervention, is Wiseman's claim that no real programme could ever be implemented under the name of MBE.<sup>1</sup> For any politician to explicitly propose an MBE programme would be 'unthinkable in liberal states' and 'political suicide', so any MBE programme must be 'indirect, subtle' and 'covert' (p79, emphasis Wiseman's). If true, the criticism may seem damning for any authors who defined MBE as interventions *intended* to cause moral improvement. However, I defined MBE as interventions that *actually* cause moral improvement, regardless of intent. Any intervention can then be judged as MBE or not based on its actual success. If Wiseman<sup>1</sup> is correct, then the benefits of MBE must be framed persuasively without 'bringing the word "morality" into the equation at all' (p79)—which is not merely possible but normal

for the interventions I recommend. When Goldstein and Masciulli<sup>25</sup> proposed mandatory trace lithium supplementation, they never used the words 'moral' or 'morality'. Instead, they emphasised reducing suicide. Even when discussing violent crime, they treated it like a public health problem. Many MBE interventions could be called medical treatments for PFC dysfunction. For an even more amoral framing, MBE could appeal to the government's financial incentive to reduce violent crime. A cost-benefit analysis of MBE for violent offenders would likely be favourable to MBE.

MBE could be implemented by private organisations, making its political feasibility less relevant. Insurance companies are even more likely to look favourably on a cost-benefit analysis of MBE interventions than governments. Insurance companies could plausibly offer discounts for undergoing MBE interventions likely to reduce costly, harmful behaviour—discounts that would be especially attractive for easy and non-invasive omega-3, lithium and tDCS MBE interventions. Voluntary MBE may not even need incentives if enough people want to morally enhance themselves. So, there may be several feasible ways to implement safe and effective MBE interventions. If the traits that they enhance are good, and MBE is not wrong in principle, then those interventions should all be seriously considered as methods to implement MBE.

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