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Enhancement and Civic Virtue

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Abstract

Opponents of biomedical enhancement frequently adopt what Allen Buchanan has called the Personal Goods Assumption. On this assumption, the benefits of biomedical enhancement will accrue primarily to those individuals who undergo enhancements, not to wider society. Buchanan has argued that biomedical enhancements might in fact have substantial social benefits by increasing productivity. We outline another way in which enhancements might benefit wider society: by augmenting civic virtue and thus improving the functioning of our political communities. We thus directly confront critics of biomedical enhancement who argue that it will lead to a loss of social cohesion and a breakdown in political life.

Keywords

Biomedical Enhancement; Cognitive Enhancement; Moral Enhancement; Civic Virtue; Allen Buchanan; Personal Goods Assumption; Social Cohesion

Developments in biomedical science are giving rise to new techniques to enhance the physical, cognitive and even the affective capacities of human beings. The development and potential use of these techniques, which we shall refer to as biomedical enhancements,¹ has generated considerable controversy. Whereas the use of medical interventions to treat the sick is widely regarded as ethically unproblematic in most cases, the prospective use of new technologies to enhance normal, healthy people has prompted a range of objections.

Some of these objections appeal to the motives for which biomedical enhancement might be pursued. For example, Michael Sandel has written that “the deepest moral objection to enhancement lies ... in the human disposition it expresses.” It “represent[s] the one-sided triumph of willfulness over giftedness, of dominion over reverence, of molding over beholding.”² Others question the means by which biomedical enhancement is achieved, sometimes claiming that it amounts to a form of cheating,³ or holding that biomedical means

to enhancement are problematic because they are unnatural, in the sense of being abnormal, artificial, or contrary to the natural moral law.⁴ However, perhaps the richest set of objections points out various negative consequences or implications of biomedical enhancement, either for the enhanced individual, or for others.⁵ It has been claimed, for example, that biomedical enhancements might alienate the enhanced individuals from their true or authentic selves,⁶ restrict the enhanced person's freedom or autonomy,⁷ put unenhanced individuals at an unfair competitive disadvantage,⁸ extinguish or devalue the rights of unenhanced persons,⁹ undermine social solidarity,¹⁰ poison or undermine healthy family and romantic relationships,¹¹ or exacerbate existing unjust inequalities.¹² These considerations have often been taken, either alone or in combination, to weigh decisively against all forms of biomedical enhancement.

In recent work, Allen Buchanan has criticised the proponents of these concerns—and indeed of existing responses to them—for neglecting to consider the significant social benefits that biomedical enhancements might have. In his article “Enhancement and the Ethics of Development” and his books *Beyond Humanity?* and *Better Than Human*, Buchanan argues that biomedical enhancements may benefit society through increasing the productivity of the enhanced individual.¹³ The social benefits of productivity-increasing enhancements should be familiar to us, he suggests, because such enhancements have been used for millennia. On Buchanan's view, the new biomedical enhancements under discussion are but a novel extension of a broad set of enhancement tools that includes education, agricultural techniques, and legal and political institutions.

In section I, we outline Buchanan's critique of existing discussions of the ethics of biomedical enhancement. In section II, we build upon his positive project of reframing the biomedical enhancement debate by arguing that widespread use of biomedical enhancements can be good for society in a *second* way – through contributing to civic virtue and thus improving the functioning of our political communities. The topic of civic virtue has received renewed attention over the last two decades both as part of a revival of republicanism in political philosophy¹⁴ and in response both to the challenges of multicultural politics and to concerns over low levels of civic and political engagement.¹⁵ In many countries, these problems of citizenship have been reflected in a renewed focus on ‘citizenship education.’¹⁶ We argue that some biomedical enhancements may help with these problems, and that this is an important consideration so far neglected in the debate.

In making this argument, we seek to buttress Buchanan's claim that the project of biomedical enhancement could have important social benefits. However, the *character* of the benefit we introduce is of particular force in the debate. In claiming that enhancements can improve the functioning of our political communities, we are tackling head on the critics of enhancement who claim the opposite.¹⁷ Whereas such critics might reply to Buchanan that increased productivity is a minor concern relative to the threat of losing social cohesion and a breakdown in political life, such a reply cannot be made to our argument. Our point is precisely that some forms of biomedical enhancement, appropriately used, could play a key role in *defending* these values.

In section III, we move on to consider two possible responses to our argument. Firstly, we consider whether there really is need for widespread increases in civic virtue amongst the citizens of modern liberal democracies. Secondly, we discuss whether unequal access to biomedical enhancements might lead to the emergence of an elite social group that is virtuous in so far as it expertly engages in politics, but damaging to society in so far as it uses its political ‘virtues’ to serve its own interests. Following that, in section IV, we reconsider Sandel’s concerns, and discuss the net impact that biomedical enhancements might have on social solidarity. Finally, in section V, we briefly discuss the implications of our argument for existing critiques of biomedical enhancement and outline its possible relevance to positive arguments for it.

I. RE-FRAMING THE ENHANCEMENT DEBATE

Buchanan claims that the debate about the ethics of biomedical enhancement has, to date, been guided by the following framing assumption

Personal Goods Assumption: the most significant benefits [of biomedical enhancement] are private or personal goods, that is, advantages to the persons who are enhanced (or to their parents in the case of enhanced children).¹⁸

Grounding this assumption, Buchanan suggests, are two further assumptions. Firstly, that enhancement will be a “zero sum affair,” in which any benefits an individual gains through undergoing enhancement are obtained through out-competing other individuals. Accordingly, those benefits—from beating a rival to a job, or winning a sports competition—are, from an impartial point of view, cancelled out by the losses incurred by the now-beaten individuals.¹⁹ Secondly, it has been assumed that use of enhancements will have deep negative impacts on society. As mentioned above, for example, it has been argued that use of enhancements may increase social divisions and erode social solidarity.²⁰

Buchanan argues that these assumptions have skewed the debate by diverting attention away from important social benefits that enhancements might have. In particular, he argues that “some enhancements will increase human productivity very broadly conceived and thereby create the potential for large-scale increases in human well-being.”²¹ We should, Buchanan concludes, *re-frame* the debate about biomedical enhancement by giving serious consideration to the social benefits that enhancements might have.

In what follows we build upon Buchanan’s argument by highlighting a second type of social benefit that biomedical enhancements can have. Some biomedical enhancements, we argue, would promote civic virtue and thus help to improve the functioning of modern liberal democracies. To introduce this argument, it will be helpful to explain a methodological approach to the enhancement debate that we borrow from Buchanan. Buchanan sees the new biomedical enhancements as high-tech versions of long-established practices²² and argues that “for the most part the concerns about enhancement apply, not just across a wide variety of modes of biomedical enhancement, but to nonbiomedical enhancements as well.”²³ Consequently it is natural for him to draw on literature discussing traditional practices to generate insight about how we should think about the new high-tech practices. In particular,

he deploys insights from the ethics of development to the biomedical enhancement debates.²⁴

The foundation for his method might be made explicit in the following formulation:

The Relevance Thesis: New biomedical enhancements are sufficiently similar to ‘traditional’ methods of enhancement to make ethical debates surrounding the second relevant to the first.

Buchanan clearly accepts the Relevance Thesis when he contextualises bio-medical enhancements in a long tradition of enhancement techniques and highlights parallels between the two types of enhancement. In support of the Thesis, he argues that there is no fundamental or universal morally difference between biomedical enhancements and more traditional enhancements.²⁵ In particular, both types of enhancement can, he notes, affect our internal states as well as the external environment, both can have irreversible effects, including genetic effects on future generations, both can lead to changes in what kinds of human capacities quality as normal, both could be regarded as ‘unnatural’ in similar ways, and both could be used in ways that produce distributive injustices.²⁶

The Relevance Thesis has enormous implications for the enhancement debate because it expands the relevant literature from the recent writings about biomedical enhancement to the huge and multi-faceted literature on traditional methods of improving human capacities. Following Buchanan’s treatment of the ‘Ethics of Development,’ we might ask: what other bodies of work might have useful insight for contemporary biomedical enhancement debates? In particular, given that we can view education as a powerful and pervasive form of traditional enhancement, we can ask: what social benefits have been attributed to education that might also apply to other enhancements?

It is a widely held view that there are significant private gains to education—enhancing yourself by studying at school or university makes you better off. To some extent, this is simply because it allows you to outperform less enhanced individuals in the job market. If an extra qualification benefits me because it enables me to beat you in a job application, my gain is offset by the loss to the less enhanced individual who now loses out on the job. Yet it would seem implausible to suggest that there was no net social benefit from education. One of the reasons for this is that, in some sectors, giving workers more education increases their productivity, and this in turn tends to increase the productivity of those that they work with. It may also allow them to produce work that has broad social benefits, such as coming up with new medicines or technologies. There is another way in which education has social value. In public economics, for example, “it is widely believed that education is an essential component of a stable democratic society because it encourages citizens to participate in democratic processes and prepares them to do so in an informed and intelligent manner.”²⁷ When considering new biomedical enhancement techniques, therefore, we should also ask: might they also have social value through promoting good citizenship?

We now move to construct our argument that some biomedical enhancements could contribute to the development or realisation of civic virtues. This raises the question of what

the civic virtues are. We then describe how certain forms of biomedical enhancement could contribute to the development or realisation of these virtues.

II. CIVIC VIRTUE AND BIOMEDICAL ENHANCEMENT

A. CIVIC VIRTUE

Following Dagger,²⁸ we will take a civic virtue to be a quality (ability, attitude or disposition) that is needed in order to perform one's role as a citizen well. We take it also that one important role of the citizen is to contribute to the political functioning of her community. Thus, we assume, qualities of citizens which reliably contribute to the good functioning of a polity will qualify as civic virtues, and how well a political community functions will depend substantially on the degree to which its citizens possess those virtues.²⁹

We do not intend to provide a comprehensive inventory of civic virtues or to exhaustively survey the immense literature on this topic.³⁰ Rather, we aim to identify a small number of core civic virtues that we think biomedical enhancements might help develop. We do this by summarising recent discussions which highlight concerns about the levels of civic virtue in modern liberal democracies. Firstly, we look at the question of whether citizens have sufficient tolerance and solidarity towards one another to secure social cohesion in multicultural societies. Secondly, we briefly examine the phenomenon of 'political disengagement' amongst modern electorates.

i. Social Cohesion—Broadly speaking, the level of social cohesion of a political community is the extent to which its members identify with one another. Social cohesion gives rise to trust and makes citizens more willing to co-operate with one another, making it easier to solve collective action problems, and to maintain law and order. There have been two kinds of concern about whether there is enough social cohesion in modern liberal democracies.

In the first place, the presence of diverse cultural and ethnic groups within modern states may make it harder to maintain social cohesion. According to Kymlicka and Norman, fractious debates over multiculturalism have been a key driver behind the resurgence of interest in citizenship amongst political theorists.³¹ These debates typically operate from the starting assumption that society requires a certain amount of social cohesion between its citizens in order to operate, and proceed to ask questions such as whether granting special rights and privileges to minority groups would undermine (or promote) this cohesion. A related issue is that of whether—in order to secure the requisite cohesion—citizens need to endorse a kind of 'Liberal Nationalism.'³²

For Kymlicka and Norman, these issues emphasise the importance of citizens having one virtue in particular—a *willingness to engage in public discourse*—even with individuals they might strongly disagree with (the corollary of this is that the citizen restrains from coercive or manipulative responses to conflict).³³ This highlights the importance of related virtues such as having feelings of solidarity towards one's fellow citizens, as well as not holding prejudices towards other groups.

Public engagement should ideally be tolerant, respectful rational dialogue.³⁴ It involves respecting others with different values and being open minded. The hallmark of a liberal society is its ability to form and revise policy, and individual opinion, in the light of reason and evidence.³⁵

Tolerance also involves toleration of difference, including difference one chooses not to correct. A liberal society should offer opportunity, not enforce outcome. Concerns about social solidarity are justified if we are talking only about cognitive enhancement but we are considering a much broader range of virtues promoting liberal citizenry.

A second type of concern is that declining participation in traditional forms of community life might inhibit the maintenance of social cohesion. In 1995, Robert Putnam published a controversial article collating empirical research on the decline of ‘social capital’ in the US.³⁶ Comparing modern levels with those of the 1960s, participation in formal organizations like churches, labour unions, parent-teacher associations, sports groups etc. had dropped drastically – by up to 50% in many cases. Combined with the well-documented trend towards the break-up of family structures, and reduced trust in neighbourhood communities, this led Putnam to a shocking conclusion: American civil society, once viewed as a shining example of good practice, was in crisis. These trends appear to be replicated in many other established democracies (though perhaps not all).³⁷

There are then, powerful worries about the level of social cohesion in modern liberal democracies. These worries suggest the importance of several inter-related civic virtues: attitudes of solidarity with other citizens, freedom from prejudice, willingness to participate in community life, and willingness to engage in public discourse.

ii. Political disengagement—A second reason for the renewed interest in citizenship has been concern over levels of ‘voter apathy’. While it is easy to exaggerate the concern, data suggest that in most major established democracies, there have been declines in voter turnout for the major national elections since 1950.³⁸ Membership of political parties has dropped off even more rapidly,³⁹ and taken together, these statistics could be taken to indicate that electorates have become increasingly disengaged with politics.

This conclusion, however, may be too strong. It may be that citizens are participating in politics via other means, perhaps through lobbying groups, direct action campaigns or protests. A more direct indicator of ‘political engagement’ is the level of knowledge about politics that the average citizen has. And here the consensus is (at least in the US) that “popular levels of information about public affairs are, from the point of view of an informed observer, astonishingly low.”⁴⁰ The ‘information’ discussed here is information about political structures, candidates in elections, and their policy manifestos. Numerous surveys have been done showing that while citizens can recall trivial facts about politicians (pet names etc.) they often fail to know basic things about their policy packages.⁴¹ Indeed, academics have struggled to explain how democracy works at all, given that it places decision-making power with such poorly informed electorates.⁴²

Many thinkers have sought to explain this ‘paradox’ with theories that show how democracy can function with a minimally informed average citizen.⁴³ Firstly, it has been argued that citizens employ heuristics which allow them to make political judgments with very little information. Secondly, it has been suggested that democracy only requires a small subset of informed citizens to play a watchdog role over expert governors. Thirdly, it has been claimed that collective public opinion can be rational, even if the individual opinions underlying it are not, if, for example, individual errors are randomly distributed and cancel each other out when aggregated together.

Although these arguments may go some way towards explaining how democracy functions with an apparently ill informed electorate, they do not hide the fact that electorates don’t know much, and that it would be better if they knew more. Indeed, all of these theories concede, or imply, that increasing the knowledgeability of the electorate would increase the quality of their judgements, and thus of democratic outcomes. Thus, after considering these issues, Carpinì concludes, “While it is impossible to identify the specific pieces of information necessary for assuring good citizenship within this context, clearly some information is important, and all other things being equal, more information is better than less information.”⁴⁴

iii. Summary: Cognitive and moral components of good citizenship—From the preceding discussion, we can identify two (inter-related) groups of civic virtues. Firstly, there are *cognitive* virtues. Democracies function more effectively when citizens have political knowledge—of electoral candidates, their policies and of information relevant to evaluating those policies—and the cognitive skills that help them acquire, maintain and apply that knowledge. Secondly, there is an affective and motivational, aspect to civic virtue. It is important to have citizens who are motivated to vote, learn about politics, and to participate in community life, as well as endorsing democratic norms such as tolerance, and feeling a sense of solidarity towards their fellow citizens. Importantly they should engage in open rational dialogue, respecting others with different values and being prepared to revise their own moral views in the light of reasons and evidence.

This account helps clarify how biomedical enhancements could promote civic virtue. The cognitive aspects of civic virtue can be promoted through formal and informal education, and biomedical cognitive enhancements could be used to augment and accelerate that education. Moreover, there is evidence to suggest that promoting the cognitive aspects of civic virtue has positive knock-on effects on the affective, or motivational, aspects of good citizenship.⁴⁵ Finally, it may also be possible to develop biomedical enhancements which directly develop the conative and affective aspects of civic virtue. We now elaborate on these points in more detail.

B. CIVIC BENEFITS OF COGNITIVE ENHANCEMENTS

In this section, we outline how cognitive enhancements might contribute to the development of civic virtues. To begin, we summarise a range of biomedical enhancement techniques that are either available now, or likely to be developed in the future. We then discuss how such biomedical enhancements might—in conjunction with education—contribute to civic virtue.

i. Bio-medical Cognitive Enhancements—The science of cognitive enhancement is in its infancy but there is some evidence that a range of currently available drugs can, under laboratory conditions, augment performance on certain cognitive tasks, including tests of concentration, working memory and executive function. The most commonly used of these drugs is caffeine. Other drugs for which there is some evidence of cognitive enhancing effects and which have been used for purposes of cognitive enhancement include Ritalin (methylphenidate), Adderall (an amphetamine salt), and Provigil (modafinil).⁴⁶ Though the effects of these drugs outside of laboratory contexts are not well understood, their cognitive enhancing effects under laboratory conditions make it reasonable to suppose that they *may* have cognitive enhancing effects in other contexts as well. Moreover, even if these drugs would not have cognitive-enhancing effects outside the laboratory, their laboratory effects make it plausible that future versions of these drugs or other drugs (possibly initially developed to reverse cognitive impairment such as memory impairment in Alzheimer's Disease) will be more effective enhancers, and will have fewer side effects.

Non-invasive brain stimulation such as transcranial electrical stimulation (TES) and transcranial magnetic stimulation (TMS), especially in combination with behavioral training, offer potential nonpharmaceutical alternatives for cognitive enhancement. For example, Transcranial Direct Current Stimulation has already been shown to be effective at improving mathematical ability in children with low numeracy skills under laboratory conditions.⁴⁷ Again, even if these results turn out not to generalise outside the laboratory, they make plausible the suggestion that future brain stimulation technologies might have significant cognitive enhancing effects in non-laboratory use, at least when coupled with appropriate training.

We do not wish to make any bold claims regarding the likely availability and effectiveness of biomedical cognitive enhancers in the future. We assume only that the likelihood that we will have effective biomedical cognitive enhancers in the short-to-medium term future is sufficient that the ethical considerations bearing on their use warrant discussion now. This empirical assumption seems to us plausible, and it is of course endorsed by most authors on both sides of the ethical debate over biomedical enhancement, though it has been disputed.⁴⁸

We now argue that one important benefit of biomedical cognitive enhancers may be to contribute to the development or realisation of cognitive virtues.

ii. How cognitive enhancements could contribute to civic virtue—The most obvious way in which cognitive enhancements could contribute to civic virtue is by facilitating the process of acquiring and applying political knowledge. In the first place, we suggest, cognitively enhanced individuals would learn more from existing programs specifically aiming to teach 'good citizenship'. Such programs teach students about how political institutions work, or about local political issues, or about political values.

But civic education does not just take place in civic education classes. Rather, the whole system of formal primary, secondary and tertiary education can be seen as a tool for promoting good citizenship. Promoting citizenship is not the only important benefit of such education—it also prepares young people for the workforce, and gives them skills necessary

to lead an autonomous life—but it is an important one. To see this, note that basic literacy and numeracy skills are a pre-requisite for many of the civic virtues discussed above. Unless you can read, and work with numbers, it would be very hard to make informed voting decisions. In addition, subjects like history and literature develop critical thinking skills that can be applied to politics. Learning science and social science helps you understand policy debates. And it cannot be ruled out at this stage that this kind of educational effort could be improved or facilitated using biomedical means.

At present, many education systems are instilling these skills only in a proportion of students. For example, it is estimated that one needs an IQ of around 90 to complete a US tax return, meaning that more than 20% of the adult population is unable to do so.⁴⁹ Widespread biomedical enhancements of learning ability which amplified the effects of basic education could be expected to increase the proportion of individuals who develop the literacy, numeracy, critical thinking skills and subject-specific knowledge required for effective political participation.

Note that the benefits of cognitive enhancement for effective citizenship need not be limited to the formal education of younger individuals. During our adult lives, we are continually learning about politics through our exposure to media such as newspapers, the internet and television. If cognitively enhanced individuals could acquire more of this information faster, then they would be more politically knowledgeable than they otherwise would, and would thus be better citizens.⁵⁰

Of course, political knowledge and other cognitive elements of civic virtue may not, by themselves, amount to much. It would not be much use to have citizens who are well informed but lack the motivation to vote, or who vote on the basis of anti-democratic values. Accordingly, we now turn to examine empirical evidence which suggests that better-informed citizens also tend to be better citizens in a broader sense.

iii. Empirical Evidence—Attempting to summarise the relevant literature on this matter, Carpini argues that the balance of evidence supports the view that more informed citizens are ‘better’ citizens, in a broad sense:

Specifically, research has found that more-informed citizens are more accepting of democratic norms such as political tolerance, are more efficacious about politics, are more likely to be interested in, follow and discuss politics, and are more likely to participate in politics in a variety of ways, including voting, working for a political party, and attending local community meetings.⁵¹

There is also evidence to suggest a strong correlation between *educational attainment* and good citizenship. For example, the OECD concludes that “people with more schooling are likely to make more informed choices when voting and to participate more actively in their communities.”⁵² Such data support our argument, on the assumption that increasing an individual’s cognitive ability increases the chance that they will stay in education longer, or allows them to achieve educational outcomes typically associated with longer periods of education in the same period.

Other suggestive evidence linking cognitive ability of electorates to positive political outcomes is provided by McDaniel, who has analysed data on individual states in the US and reports ‘preliminary’ findings that having higher average population IQ is correlated with having less violent crime, and more effective governance.⁵³

An obvious challenge to these points is that the cited correlations between education and civic virtue do not alone show that the former causes the latter. One might wonder whether the causation runs ‘backward’ (being a better citizen makes one more likely to undertake more education and learn more about politics), or whether there are third variables (such as coming from a politically engaged family) which cause individuals to be better educated in general, better informed about politics and a better citizen broadly considered. There are, however, several studies which have attempted to address these concerns, and which suggest that increased education *causally contributes to* civic virtue. For example, on the basis of an international study spanning the second half of the twentieth century, Rindermann concludes that: “Education and cognitive abilities have a positive impact on all analysed political outcomes including democracy, rule of law, and political freedom.”⁵⁴ If education does indeed have a positive influence on the development of civic virtue (and not merely its cognitive elements), then it is plausible that at least some biomedical enhancements that enhance education will also have a positive influence: namely, those which (i) enhance learning ability and thus generally amplify the effects of education, and (ii) are used in conjunction with education.

B. CIVIC BENEFITS OF MORAL ENHANCEMENTS

Having considered how cognitive enhancements might be used to promote good citizenship, we now consider the role for ‘moral’ enhancements. The idea of morally enhancing ourselves is one of the more recent additions to the debate about biomedical enhancement debates. For example it has been argued that, at least in some circumstances, we would have reasons to undergo enhancements that would alter our conative or affective states so as to make them more conducive to morally good motivation or conduct.⁵⁵ It has been suggested that such enhancements might operate by, for example, influencing dispositions towards aggression, racial prejudice and sympathy.

Such biomedical moral enhancements are likely to be more controversial than the kinds of biomedical cognitive enhancement discussed earlier.⁵⁶ Our purpose here is not to provide an all-things-considered argument in favour of them, but to point out one valuable outcome that they might produce: they may, through contributing to civic virtue, help to secure the good functioning of our political institutions and processes. One way they could do this is by facilitating the dispositions towards cooperativeness and trust that plausibly underpin social solidarity.

It might be thought that this discussion of moral enhancements is irrelevant, because we currently lack any means of bringing about such enhancements. However, recent years have seen dramatic advances in the scientific understanding of the neural bases of our moral capacities. The study of pharmacological influences on moral decision-making is an increasingly active area of research and several recent studies have already reported that psychopharmacological interventions can increase trust and cooperation in economic games,

reduce people's willingness to directly harm others, and diminish violent re-offending.⁵⁷ Though we are currently very far from having even minimally reliable means of facilitating conative and affective bases social cohesion, it is reasonable to take seriously the possibility that we might have such interventions in the future. Moreover, there are other kinds of intervention which might be used. For example, 'neurofeedback' techniques in which individuals engage in emotional training tasks while being provided with real-time feedback on neural activity have already been shown to allow the rapid alteration of emotional responses in laboratory settings.⁵⁸

C. INTERIM CONCLUSION

Our main focus in this section has been to argue that certain kinds of cognitive enhancements may have an important social benefit in so far as they contribute to the development of civic virtues.⁵⁹ In some cases, these interventions might be used with the purpose of enhancing civic virtue. But even where individuals biomedically enhance themselves or their children with purely self-interested aims in mind, their efforts might lead, as a side effect, to the development of civic virtues. For example, parents might provide learning ability enhancements to their children solely with the aim of improving their children's career prospects. However, insofar as those enhancements generally amplify the effects of basic education, they might be expected, in some cases, to contribute to the cognitive bases of civic virtue. In individuals who already possess the conative and affective bases of civic virtue, such enhancements could be expected to contribute to the development of the civic virtues themselves. Moreover, there is some evidence from studies of education suggesting that such uses of enhancement might also indirectly foster the conative and affective aspects of civic virtue. Finally, we have also tentatively suggested, drawing on recent literature on moral enhancement, that it may be possible to more directly biomedically enhance the conative and affective bases of moral motivation and conduct in ways which would increase civic virtue.

Taken together, these considerations suggest that biomedical enhancements could have important social benefits through contributing to civic virtue. This consideration has been neglected in the biomedical enhancement debates and strengthens Buchanan's critique of the assumption that "the most significant benefits [of biomedical enhancements will be] private or personal goods, that is, advantages to the persons who are enhanced (or to their parents)."

Having laid out our core argument, we now consider several possible responses to it.

III. RESPONSES

We suspect that two main kinds of response will be made to our claims. First, one might accept that biomedical enhancements could contribute to civic virtue but deny that there would be any significant value in this outcome. Secondly, one might tackle our argument head-on, denying that there are, or will be in the near future, any biomedical enhancements that would promote civic virtue in the ways we suggest.

An argument of the second kind might appeal to the observation that some of the possible cognitive enhancers that we mention above—especially methylphenidate—have already

been in use for a number of decades, yet they do not appear to have given rise to any increase in civic virtue. Indeed, their use has coincided with a putative decline in civic virtue.⁶⁰ This observation is, we think, consistent with our claim that future biomedical enhancers would plausibly be capable of increasing civic virtue.

First, though methylphenidate and a number of other drugs have elicited cognitive-enhancing effects in laboratory settings, it may be that these effects do not generalise outside of laboratory settings, or at least, not to settings in which methylphenidate has been used outside the laboratory to date. Thus, we would not expect to have seen any beneficial effects on civic virtue. Nevertheless, as noted above, the fact that these agents have had cognitive-enhancing effects in the laboratory helps to make plausible the suggestion that future variants on these agents—or other drugs—would have more robust cognitive enhancing effects.

Second, even if existing stimulant drugs *have* had significant cognitive-enhancing effects outside the laboratory, we should not expect this to have produced a positive effect on civic virtue. This is primarily because these drugs have not been used in ways that would plausibly produce such an effect, which is unsurprising since it is only recently that their civic-related value has been studied. They have been used for a narrow range of purposes, primarily behavioural improvement of children with ADHD. They have not, for example, been used in conjunction with intensive civic education programmes. It may be, then, that these drugs have enhanced some cognitive components of civic virtue, but in circumstances where other cognitive, conative or affective components are absent. If the missing components are *necessary* for the realisation of civic virtue, then we would not expect the use of these drugs to have increased civic virtue.

Third, it is in fact quite possible that use of methylphenidate and other stimulant drugs have had a positive impact on civic virtue, but this has been outweighed by countervailing negative influences, perhaps social influences of the sort discussed by Putnam.⁶¹

Let us return, then, to the first kind of objection, which accepts that biomedical enhancements could contribute to civic virtue but denies that there would be any significant value in this outcome. We suggest that it is unlikely that a critic would want to claim that civic virtues under discussion were not important *at all*. Yet one might plausibly argue that there is already *enough* civic virtue in modern liberal democracies and thus that there was no significant benefit to increasing it. Alternatively, one might argue that although more civic virtue, equally distributed, would be better, this is not the scenario that is likely to obtain. Rather, it may be that elites monopolise the use of biomedical enhancements and that the resulting unequal distribution of civic virtue (if you could still call it that), would not be a good thing. We now respond to these objections in turn.

A. DO WE NEED MORE CIVIC VIRTUE?

A more developed version of the objection outlined above might run as follows. Civic virtue is valuable only insofar as it helps to maintain social cohesion and facilitate good democratic decision-making, thus, if we have enough civic virtue to maintain these things, there would be no value in acquiring greater civic virtue. And when we look at modern liberal

democracies, the objection would continue, it appears that we do have enough civic virtue to maintain social cohesion and good democratic decision-making: there is no evidence of political crisis. Our communities are not at risk of falling apart, and our democracies are healthy. Consequently, there is no need for improved civic virtue.

We offer three replies to this argument. First, in the context of the literature cited above expressing deep worries about the health of both our civic and political life, it would be a bold claim to assert that our polities are well functioning. Second, the concept of a well functioning state is not a threshold concept. Thus, even if our states are functioning well, they could function better, and increases in civic virtue would make them do so. Moreover, it is implausible to suggest that there would be no value in such an improvement in political functioning. Political functioning does not lose all value above some threshold. Third, even if everything has been going well until *now*, there is reason to increase civic virtue to ensure that our states are capable of dealing with future challenges.⁶² Economic shocks, environmental disasters or dramatic technological developments may threaten social cohesion, and new policy challenges may emerge that expose the frailties in democratic processes. This last point in particular is worth expanding upon.

Our general claim here is that the development of technology gives rise to new policy challenges that are both important and difficult to solve. A contemporary example of such a challenge is provided by the debate on climate change and carbon emissions reduction. Getting policy in this area right is immensely important. If the predictions of ‘pessimistic’ scientists are correct and we are heading towards catastrophe if we continue with business as usual, then failing to significantly cut emissions now is to put the future of humanity in jeopardy. On the other hand, if fears about climate change are over-blown, then making big cuts to emissions inflicts a large and unnecessary cost on all of us.

At the same time, challenges like these place huge cognitive demands on electorates. The science is hard to understand, and involves the aggregation of huge amounts of data. Moreover, decisions here involve weighing risks, and considering trade-offs between present costs and far-off benefits. Given that all of this creates problems for the experts, it is not surprising that it would be challenging for the average citizen who lacks the time and specialised training to gain a detailed understanding of these issues. Yet if citizens do not understand the rationale behind climate change policy, how can they be expected to offer support to politicians seeking to make policy choices that involve sacrifices now in order to reduce the risk of climate deterioration later, far into the future?⁶³

There is a wealth of similarly challenging policy decisions that we already face, such as the prevention of terrorist attacks, including attacks using nuclear or biological weapons, policy regarding the use of nuclear weapons, policy on nuclear power stations, the regulation of global financial markets, and oversight of the internet. Looking further into the future, we might add to that list the regulation of potentially dangerous new technologies – such as artificial intelligence technology and nanotechnology.⁶⁴ In each of these cases, there is a potential for very bad outcomes to materialise if policy is made poorly and there is also ample reason to think that our societies are ill suited to make good policy in these areas.⁶⁵

In order to prepare our democracies for the policy-making challenges of the future, therefore, we suggest that it would be helpful to increase levels of civic virtue. At this point, a critic might reply that what is required is not to enhance the average citizen, but to enhance our rulers. If what we are really worried about is challenging policy decisions, then why not just enhance the leaders that are actually making those decisions on a day-to-day basis?

The suggestion of enhancing political leaders is an interesting one. Political leadership is certainly cognitively demanding,⁶⁶ and there is obviously a precedent of using education to improve the knowledge and cognitive capabilities of such leaders. This would naturally lead one to wonder whether there was a role for biomedical enhancements to obtain further improvements. However, we suggest that *only* enhancing political leaders is unlikely to solve our problems. In the first place, you would need a way of ensuring that the enhanced individuals actually got elected, and there is evidence to suggest that electorates may be put off candidates that are more than about 20 IQ points more intelligent than them,⁶⁷ implying that increases in electorate intelligence would be required to ensure a cognitively enhanced got elected. Moreover, once in office, it would be up to the electorate to play a watchdog role in ensuring that the cognitively enhanced leader did not become corrupt, and this watchdog role is itself likely to be cognitively demanding. Finally, even if enhancing political leaders would solve the policy-making problem, promoting civic virtue amongst the broader population would still be required to meet worries about social cohesion.

An alternative response to our argument above would hold that cognitive enhancements are self-defeating as a means to better functioning polities. Suppose that the use of cognitive enhancements becomes widespread, raising ability levels significantly. For a given set of policy problems, citizens will be better placed to understand them. But, because scientists are now smarter, and technological progress accelerates, the widespread use of enhancement would create new, more complex policy challenges. Citizens would still struggle to keep pace with the latest policy challenges.

In response, note first that this objection only applies to one aspect of our case for cognitive enhancements. Even if, on balance, such enhancements did not improve the ability of citizens to evaluate policy decisions, they would still have benefits by improving the other aspects of civic virtue discussed above. Secondly, we should distinguish between the use of cognitive enhancements by scientists, and the use of such enhancements by the population at large. Our core argument is that the latter use would have important civic benefits. It may be that widespread use of cognitive enhancements inevitably also means use by those involved in science. But whether that is a problem or not depends on the trade-off between the benefits of scientific progress and the threat of creating dangerous new technologies that democracies struggle to regulate. One thing is clear: if science is to continue with the aid of cognitive enhancements, then there will be good reasons for widespread use of such enhancements to enable electorates to ‘keep up’ with the complex questions raised by new technologies.

B. PROBLEMS OF UNEQUAL DISTRIBUTION

In the previous section, we argued for the importance of widespread increases in civic virtue in modern liberal democracies. We now turn to respond to the possibility that this scenario,

though beneficial, would not obtain, and that instead only certain elite groups in society would access the biomedical enhancements under discussion. This, the worry continues, may be problematic. Suppose that one group in society undergoes powerful cognitive enhancements, and thus becomes much more knowledgeable about politics. That group might then be better at persuading or manipulating others, deploying their knowledge of 'how politics works' to better direct their lobbying efforts. Might this group not therefore become adept at manipulating political outcomes in their favour? And thus, although *that* group would gain, might there be no net social gain?

There are two initial problems with this objection. In the first place, it could be undermined by a policy to ensure that there was a balanced distribution of the relevant enhancements amongst the population.⁶⁸ Secondly, it ignores the link between the cognitive and affective aspects of civic virtue discussed above. If smarter, more politically informed citizens are also more co-operative and more tolerant of diversity, then it is implausible to suppose that there is no net social benefit to enhancements, even if they are limited to one group.

We also find it implausible that there is no social benefit to increasing the political knowledge and cognitive skills of one group of citizens. To see this, consider an example in which *every* group of citizens was enhanced in this regard. If the benefits of enhancement were purely competitive—with private benefits offset by public costs—then no-one would be made better off by this increase in civic virtue. Every group would be better at competing to have their interests reflected in policy, but because the enhancements were equally distributed, then the outcome would still be the same and no group would be better off. Yet this seems implausible—it is reasonable to suppose that a state with a better-informed citizenry would be better managed.⁶⁹ This suggests that there are social benefits from increasing the political literacy of at least some groups of citizens. It is true that there may also be 'private' benefit, taken at the expense of other groups (that is, imposing a social cost), but this is compatible with there *also* being a social benefit, including one that, in some cases, exceeds the social cost. It is also true that some social benefits from increasing the political literacy of a group of citizens may be conditional on all other groups having increased political literacy as well, for example, because the benefits flow would flow from the development of a broad-based consensus between politically well-informed citizens. But it is plausible that, in some cases, increasing the political literacy of a subset of citizens will have social benefits that are not conditional in this way; they would flow directly from the increased political literacy of the group in question and would obtain regardless of whether others also have increased literacy. One reason for there being a social benefit of this sort is that the interests of different groups will often overlap. Thus, if one group campaigns to protect its interests, it will often also help to protect the interests of others. For example, if one group advocates improved macro-economic management, or more prudent environmental management policy, they may advance their own interests, but in doing so benefit everyone (or at least a large majority).

IV. SANDEL AND THE NET IMPACT OF BIOMEDICAL ENHANCEMENT ON SOLIDARITY

We have been arguing that biomedical enhancements could contribute to civic virtue and that this could be expected to lead to better functioning polities and to improved social

solidarity. In arguing that the use of enhancements might lead to increases in social solidarity, we are directly contradicting a claim to the opposite effect made by Sandel, to which we now turn.

Sandel has argued that the use of biomedical enhancements will lead to a break down in sympathy between successful and unsuccessful individuals, thus eroding social solidarity and undermining support for the welfare state.⁷⁰ This is because the successful will no longer regard the unsuccessful as having ‘unfortunate’ shortfalls in ability levels. Rather, they will see ability levels as an endogenous factor, subject to the control of enhancement technologies. To put it crudely, the successful might say to the unsuccessful: it is your fault if you lack the abilities to succeed in life, because you could have enhanced yourself, so I am not paying for your failures.

Several authors have criticized this argument.⁷¹ The main problem is that it is not clear why successful individuals would think that each individual was responsible for the ways in which he was and was not enhanced. Might some individuals simply not be able to afford enhancements? Moreover, Sandel focuses on *genetic* enhancements brought about through reproductive selection (that is, by the use of genetic testing by an individual’s parents), and it seems implausible to suggest I would be in any way responsible for an enhancement (or lack of enhancement) to my genes through this mechanism.⁷² To this, Sandel might reply that all his argument requires is that the successful *believe* that the widespread use of enhancements makes the ‘unsuccessful’ more responsible for their failures; it does not require that they actually are so responsible. But it is hard to see why, in the absence of robust empirical evidence, we should expect the ‘successful’ to have this false belief and, as critics have noted, Sandel adduces no such evidence.⁷³

However, even if Sandel has succeed in pointing out one way in which biomedical enhancements would undermine social solidarity, it should be clear from our discussion that this cannot constitute a ‘trump card’ against all biomedical enhancements. By ‘trump card’ here, we mean a consideration against enhancement that is decisive (that is, not outweighed by countervailing considerations) and whose decisiveness is clear in advance of weighing it against countervailing considerations—what Buchanan refers to as a ‘conclusive reason’.⁷⁴ In order for Sandel’s solidarity argument to play that role, it would have to be the case that solidarity was of fundamental importance *and* that Sandel’s argument showed that enhancement would, on balance, undermine solidarity. Yet we have argued here that some enhancements would *promote* solidarity by making individuals better citizens who are more tolerant and co-operative toward one another. Working out the net impact on solidarity would thus require a comparison of the strength of the two mechanisms through which enhancements might influence it.

V. NORMATIVE IMPLICATIONS

So far, we have sought to establish the claim that the use of some biomedical enhancements, particularly cognitive enhancements, would lead to the development of increased civic virtue, and that this implied that those enhancements had important social benefits. Our primary motivations for making this argument have been negative: to further undermine the

Personal Goods Assumption, according to which the benefits of biomedical enhancements will accrue to the individuals who undergo those enhancements, and more specifically, to undermine Sandel's solidarity-based objection to biomedical enhancement. We have not sought to establish a positive case *for* biomedical enhancement and will not do so in this final section. But we do wish to briefly indicate how our argument might figure in such a case.

Defenders of enhancement have typically argued either that it would be morally permissible, desirable or obligatory for individuals to biomedically enhance themselves or their children in certain ways, or that it would be permissible, desirable or obligatory for the state to allow or encourage the engagement in certain kinds of biomedical enhancement.

At the level of individual morality, our arguments plausibly imply that individuals have an additional reason to engage in (or provide to their children) certain biomedical enhancements—namely, those that could reasonably be expected to contribute to civic virtue. Perhaps in some cases, these reasons will be sufficient to alter the moral status of undertaking such enhancements, for example, from being impermissible to permissible, or from being merely permissible to obligatory. In order to draw any more concrete moral conclusions from our argument, however, it would be necessary to determine which kinds of biomedical enhancements could be expected to enhance civic virtue. We cannot pursue this question here, and in any case we suspect that it would be premature to make any firm claims of this sort given that the science of enhancement is in its earlier stages, however, as our arguments above indicate, we would tentatively suggest that biomedical enhancements which generally augmented learning ability and were used in conjunction with basic education would be likely to increase civic virtue.

At the level of state morality, it is even more difficult to make any firm pronouncements. If, as we have been arguing, some enhancements have important social benefits in so far as they promote civic virtue, then there will be a *prima facie* case for the state to allow and perhaps promote or even require the use of such enhancements. After all, contribution to civic virtue has often been taken to help justify a role for the state in providing and requiring such education. As an economist might put it, if a significant portion of the benefits from me biomedically enhancing myself are positive externalities – benefits that go to people who are not party to my decision to enhance myself—then I face insufficient incentive to enhance myself (because I might only care about the benefits to me) and I might not enhance, or not enhance myself to a sufficient degree. To encourage me to enhance myself more, the state will need to lower the cost of enhancement, for example, by subsidising it.

However, there are at least three considerations that might undermine or defeat this *prima facie* case. First, it might be argued, perhaps on grounds of liberal neutrality, that the state should promote only qualities whose status as civic virtues is not (or could not be) reasonably disputed, and, arguably, there are no putative civic virtues that satisfy this requirement. Thus, it might be argued, there is no civic virtue such that the state should promote the development of that virtue by promoting or requiring enhancement.

Second, it might be argued that, were a state to require or even promote biomedical enhancements it would violate certain rights that its citizens hold against it, perhaps including rights to bodily integrity, autonomy and rights against coercion and manipulation. It would thus constitute a form of wrongful interference and might even be thought to manifest or constitute a lack of civic virtue.

Third, the state is not a perfect regulator. Thus, even if the state allowed, promoted or required only biomedical enhancements that had few downsides and could be expected to greatly augment civic virtue, it would inevitably also unintentionally facilitate other biomedical enhancements, perhaps including less benign ones. Biomedical enhancements are new and potentially very powerful tools and it might be argued that the risk that they will be misused makes it too dangerous for the state to endorse even the least problematic uses of them. Of course, there are counterarguments. For example, one could argue that, even without state endorsement, biomedical enhancements are likely to be undergone covertly by some, and the state would have greater opportunities to prevent their misuse if it allowed its citizens freedom to undergo some biomedical enhancements openly.⁷⁵ But the possibility of regulatory failure is a factor that needs to be considered and we remain open to the possibility that it defeats the *prima facie* case for state endorsement of biomedical enhancements that can be expected to contribute to civic virtue.

VI. CONCLUSION

This paper has sought to rebalance the biomedical enhancement debate by identifying an important social benefit that biomedical enhancements could have and that has so far been entirely overlooked. Specifically, we have argued that biomedical enhancements, for example, of learning ability, could contribute to the development of civic virtues in those who use them. We have also argued that increased civic virtue is a social good and one that is needed in modern liberal democracies. We have thus sought to cast doubt on the assumption that the benefits of biomedical enhancements will accrue only to the individuals who use them and on Michael Sandel's claim that biomedical enhancements should be eschewed because they will undermine social solidarity. Finally, we have briefly outlined how our argument might figure in a positive case for biomedical enhancements. Here, we noted that individuals will plausibly have a defeasible moral reason to engage in (or provide to their children) biomedical enhancements that could reasonably be expected to contribute to civic virtue and suggested that these enhancements might include learning ability enhancements used in conjunction with basic education. We also noted that our argument creates a *prima facie* case for state endorsement of certain biomedical enhancements, though we acknowledged that this case may well be defeated by concerns regarding liberal neutrality, individual rights or the misuse of biomedical enhancements.

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17. See Gazzaniga. *The Ethical Brain*. p. 303
18. Buchanan. *Beyond Humanity?*. p. 35 See also Buchanan. *Enhancement and the Ethics of Development*. p. 2
19. For examples of this type of argument, see Fukuyama, *Our Posthuman Future* and McKibben, *Enough*.
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22. Buchanan. *Enhancement and the Ethics of Development*. p. 4-7.
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24. Buchanan. *Enhancement and the Ethics of Development*. p. 3-15.
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- 1999; 4(1):129–164. It should be noted that Carpini also discusses evidence that citizens from other states may be better informed, but only *slightly* better informed. See pp. 138–140.
42. Carpini. In Search of the Informed Citizen.
 43. Carpini. In Search of the Informed Citizen. p. 143–52.
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57. Crockett and collaborators report that the widely used antidepressant citalopram, a selective serotonin re-uptake inhibitor, increased aversion to directly harming others in hypothetical moral dilemmas. See their Serotonin Selectively Influences Moral Judgment and Behavior Through Effects on Harm Aversion. *PNAS*. 2010; 107:17433–38. [PubMed: 20876101] Several studies have shown that the hormone oxytocin can increase trust and cooperation in economic games. See, for example Baumgartner, Thomas, et al. Oxytocin shapes the neural circuitry of trust and trust adaptation in humans. *Neuron*. 2008; 58:639–650. [PubMed: 18498743] Kosfeld M, Heinrichs M, Zak PJ, Fischbacher U, Fehr E. Oxytocin Increases Trust in Humans. *Nature*. 2005; 435(2):673–676. [PubMed: 15931222] However, a more recent study suggests that Oxytocin has this effect only with respect to individuals perceived as belonging to one's in-group. See De Dreu, Carsten KW, et al. Oxytocin promotes human ethnocentrism. *PNAS*. 2011; 108(4):1262–1266. [PubMed: 21220339]
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59. It might seem *obvious* that cognitive improvement would be socially beneficial, and thus hardly worth arguing for this point. However, it should be emphasized that this claim is in fact implicitly or explicitly denied by many contributors to debate over cognitive enhancement – namely, those who rely on what Buchanan calls the Personal Goods Assumption. These authors accept that the

biomedical interventions could augment cognitive capacities yet argue that, even if they could do so, they would at most benefit *some* individuals, while being harmful to society. We thank an anonymous reviewer for Social Theory and Practice for pressing us to address this point.

60. We thank an anonymous reviewer for Social Theory and Practice for pressing us to consider this objection.
61. See note 36 above.
62. Buchanan makes an analogous point regarding the productivity benefits of biomedical enhancement, maintaining that, even if we might be well-off enough without those benefits now, we might require them to navigate challenges ahead without suffering substantial losses in human wellbeing. See his *Beyond Humanity?* p. 55-7.
63. This worry about 'short-termism' is articulated, in relation to climate change, in Held, David; Angus, Fane-Hervey. *Democracy, Climate Change and Global Governance: Democratic Agency and the Policy Menu Ahead*. In: Held, Hervey, et al., editors. *The Governance of Climate Change: Science, Economics, Politics & Ethics*. Polity Press; Cambridge: 2010. p. 90
64. For a survey of potentially catastrophic risks facing humanity, see Bostrom, Nick; Cirkovic, Milan. *Global Catastrophic Risks*. Oxford University Press; Oxford: 2008.
65. See Yudkowsky, E. Cognitive biases potentially affecting judgement of global risks. In: Bostrom, N.; Cirkovic, M., editors. *Global Catastrophic Risks*. Oxford University Press; Oxford: 2008.
66. See Suedfeld, Peter, et al. Assessing integrative complexity at a distance: Archival analyses of thinking and decision making. In: Post, Jerrold M., editor. *The Psychological Assessment of Political Leaders*. The University of Michigan Press; Ann Arbor: 2003. p. 246-270.
67. Gibb, Cecil A. Leadership. In: Lindzey, Gardner; Aronson, Elliot, editors. *Handbook of Social Psychology*. Addison-Wesley; Reading, MA: 1969. p. 205-282.
68. For a proposal on how to achieve a more equal distribution of access to, and uptake of, biomedical enhancements, see Buchanan. ch. 8. *Beyond Humanity?*.
69. One might also consider what would happen if you made all groups *less* informed. Presumably this would be harmful to the state, implying that there is a social benefit from each citizen being political informed.
70. Sandel. *The Case Against Perfection*. p. 89-92.
71. See Lev, Ori. Will Biomedical Enhancements Undermine Solidarity, Responsibility, Equality and Autonomy? *Bioethics*. 2011; 25(4):177–184. See. [PubMed: 20002073] McConnell, Terrance. Genetic Enhancement and Moral Attitudes Towards the Given. *Journal of Applied Philosophy*. 2011; 28(4):372–373.
72. An interesting complication is raised by the possibility that some individuals would voluntarily decide not to take available biomedical enhancements, despite these being readily available to them. Since these individuals *would* be responsible for their unenhanced state, might this reduce solidarity with them from the side of the enhanced? This is again an empirical question. We have earlier emphasized that civic education should promote tolerance for difference, and this should extend to these individuals. However, much depends here on the grounds for the refusal to undergo enhancement. If such enhancement is clearly safe, and the refusal is not backed by intelligible principled reasons, then, while we may still feel sympathy for their plight, it would still be appropriate for us to see them as at least partly responsible for it—as we would justifiably regard someone whose prospects have suffered because they voluntarily chose not to get educated on frivolous grounds. Indeed, that inequality due to voluntary choice can defeat complaints of unfairness is central to many theories of justice. Moreover, to the extent that refusal to undergo enhancement is plausibly seen as a conscious decision *not* to take one's civic duties seriously, then this may actually ground a complaint against those who make this decision, just as we criticize those who do not vote or who vote without taking the trouble to inform themselves about the issues at stake. We thank an anonymous referee for Social Theory and Practice for raising this issue.
73. Buchanan. *Beyond Humanity?*. :9.
74. Buchanan. *Enhancement and the Ethics of Development*; Buchanan. *Beyond Humanity?*.
75. Buchanan. *Beyond Humanity?*. p. 16-17. Buchanan. *Better Than Human*. p. 181-2.