

Public Attitudes Toward Cognitive Enhancement

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Abstract Vigorous debate over the moral propriety of cognitive enhancement exists, but the views of the public have been largely absent from the discussion. To address this gap in our knowledge, four experiments were carried out with contrastive vignettes in order to obtain quantitative data on public attitudes towards cognitive enhancement. The data collected suggest that the public is sensitive to and capable of understanding the four cardinal concerns identified by neuroethicists, and tend to cautiously accept cognitive enhancement even as they recognize its potential perils. The public is biopolitically moderate, endorses both meritocratic principles and the intrinsic value of hard work, and appears to be sensitive to the salient moral issues raised in the debate. Taken together, these data suggest that public attitudes toward enhancement are sufficiently sophisticated to merit inclusion in policy deliberations, especially if we seek to align public sentiment and policy.

Keywords Cognitive enhancement · Public attitudes · Fairness · Authenticity · Experimental neuroethics · Regulatory policy · Moral psychology

Introduction

Cognitive enhancement (CE) refers to the use of technology to improve normal cognitive function. A vigorous discussion over the moral propriety of CE has emerged, fueled in no small part by the recognition that cognitive ability is a key component of both prosperity and well-being [1]. The debate often pits bioconservatives against technoprogressive optimists; the former worry about the negative implications of CE on society while the latter enthuse about the possibilities that CE might afford [2, 3]. These views are tempered by those of biopolitical moderates who call for responsible discourse without advocating either widespread availability or heavy-handed prohibition [4–7]. The conversation has consistently engaged the popular press: CE is the most common subject addressed in media discussions of neuroscience [8] suggesting that readers, viewers, and listeners—the public—are similarly enthralled. Despite the public's apparent interest, their attitudes about the relevant issues in the CE debate are rarely studied. The aim of the present work is to address this gap in our knowledge by using quantitative experimental methods to study public attitudes towards CE.

At the outset it is worth clarifying what we mean by the term attitude. Called “the most distinctive and indispensable concept in contemporary social psychology” [9], the formation and function of *attitudes* has been a topic of considerable interest in the cognitive sciences [10, 11]. The attitudes that people evince can be influenced by either implicit or explicit processes. In this study, we do not lay claim to whether intuitive or

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reflective cognitive processing is at work behind individual attitudes. Rather, we investigate the public's overall judgments about the moral propriety of cognitive enhancement.

There are philosophical and pragmatic reasons for including the public in this ongoing discussion. In the philosophical literature, it is widely recognized that the debate over CE raises profound questions of who we are and who we wish to be, the answers to which are intimately tied up in individual and communal conceptions of the good life. In contemporary Western society, it is a common perception that technology in general may sometimes hold the promise of happiness but at other times disappoint, saddling us with what Taylor has termed the malaise of modernity [12]. The prospect of enhancing any one of the array of cognitive domains—memory, concentration, mood, and more—seems to be particularly effective at invoking this disquiet, but the underlying reasons remain imperfectly understood.

From a practical standpoint, understanding public attitudes towards CE is fundamental to the development of sound policy. There has been a modicum of effort devoted towards developing policy options for CEs [13–18], but little consideration given to public attitudes. Governments have hardly ignored the issue: policy debates have been initiated and commissions have issued reports [19–24], but with one notable early exception [25], there has been minimal consultation with the public. Inclusion of the public in this debate is overdue.

The public, of course, is not a monolith, but rather a conglomeration of numerous “publics.” The perspectives of specific publics have been investigated to some degree: readers of *Nature* [26], physicians [27–30], students and teachers [31–35], and those diagnosed with ADHD [36–38]. The general lay public, the ultimate consumers of CEs, have been less well studied, yet compelling arguments have been made for including the voices of the population at large in discussions of nascent technology [39–41]. Responsive to such entreaties, in the present investigation we have used quantitative methods to investigate the attitudes of the general public towards the issues in the CE debate.

Relying primarily upon quantitative rather than qualitative methods is the exception rather than the rule in neuroethics. In the present set of experiments we have used such an approach to explore the factors that might influence moral attitudes towards CE. The

ability to systematically manipulate key variables in the vignettes allows the application of experimental rigour to issues of neuroethical import. Inspired in part by experimental philosophy [42], we term this approach ‘Experimental Neuroethics’; the results allow for replication and can be built upon by other investigators. Most importantly, these tools can provide robust insights into how people think about relevant aspects of ethical issues. Thus, Experimental Neuroethics may be of general utility for the field, particularly for those investigators who are as attracted by the strengths of quantitative rigour as they are by the discernment of reflective equilibrium.

Four cardinal concerns dominate discourse on the neuroethics of CE [4–6]. The first concern is SAFETY, essentially a traditional analysis of the risks and benefits of CE, but one that is given fresh salience by the lack of medical necessity when enhancement is the objective. The second concern is PRESSURE, a term intended to exemplify the set of signals provided by either peers or society that act to effectively endorse CE use. As CE moves from novelty to norm, pressure of this sort is widely expected to increase the likelihood of CE usage. The third concern is FAIRNESS, a concept that encompasses issues of distributive justice, the problem of free riders, and sentiments of cheating. The fourth concern is AUTHENTICITY, which bears on the impact that CE might have upon character and worthiness of achievement, particularly as CE may be perceived as an effortless shortcut to success. In the experiments that follow, we probe public attitudes towards each of these cardinal concerns. While there is considerable fertile ground remaining to be explored, the results present a picture of a public that is engaged and moderate.

Experimental Methods

Because traditional stated-response surveys are notoriously unreliable [43, 44], we used the contrastive vignette technique (CVT) [45] with a between-subjects design to probe the public's attitudes towards CE. In the CVT, minimally contrastive versions of a master vignette are presented to participants who then answer identical questions regarding their attitudes towards issues presented in the vignette. Each participant is randomly assigned to a single vignette, and is *unaware* that other contrastive conditions exist. The

responses are analyzed to observe how the purposeful manipulations in the vignette affect answers, revealing underlying moral attitudes. The key outcome measure is the *difference* in group means between contrastive conditions. Indeed, the value of the CVT lies in de-emphasizing stated-preferences and focusing instead on the differences between groups.

The CVT is especially useful when probing moral attitudes, as such investigations are particularly susceptible to demand characteristics—the desire on the part of participants to appear as ‘good subjects’ [46]. The CVT mitigates such confounds by keeping participants unaware of the hypothesis under investigation. The hypothesis often investigates how a small modification of the details of the vignette (e.g., enhancement vs restoration or Susan vs Steven) might influence subjects’ answers. Contrastive vignettes have been used with considerable success in social science research [47], and more recently in the field of experimental philosophy [42, 48, 49]. The CVT allows researchers to identify the salient factors that modulate people’s attitudes towards moral issues.

Vignette Design Strategy

The vignettes were carefully crafted to insure that they were plausible, minimally contrastive, and that the results would be responsive to the hypothesis under consideration. Vignettes were analyzed using the Flesch-Kincaid Reading Ease and Grade Level readability tests, and in each instance we confirmed that the text of the vignettes would be easy for a 15- to 21-year-old to understand.

Vignettes were subject to substantive cognitive pre-testing [50]. In order to minimize hypothetical bias [44], care was taken to describe situations that hewed as close as possible to real-world situations with extant cognitive enhancements. In order to minimize bias in the results from cultural attitudes framing pharmacological agents as *illicit drugs*, we only used the term ‘pills’ in our vignettes. In order to control for preconceived antipathy towards technology, in several experiments we used multiple CE modalities (i.e., pill, electrical brain-stimulation device, and software-based brain-training exercise), all of which were designed to resemble existing technologies: the pill as psychostimulant, the electrical brain-stimulation device as transcranial direct current stimulation (tDCS), and the software-based brain-training exercise as an available commercial product.

Sample Population & Survey Format

Participants were recruited via Amazon’s Mechanical Turk. The demographic characteristics of participants on Amazon’s Mechanical Turk are more representative than the common (and extensively criticized) practice of using undergraduate students for experimental work [51–57]. To preclude participants from partaking in the same survey multiple times, we used blocking cookies and, as added insurance against such contamination, manually removed data from participants with the same IP address.

Surveys were administered using Fluid Surveys (<http://fluidsurveys.com>). Prior to initiating the survey, participants provided informed consent and were presented with a brief demographic questionnaire; the minimum inclusion criterion was that participants be 19 years of age or older. After reading through their vignette, participants were presented with a series of questions and used 9-point Likert scales to respond. Additionally, we included an optional space for participants to explain the rationale behind their choices. We did not employ semantic coding and analysis of these qualitative responses, as they were optional, but we did take them into account for design and quality control purposes. To confirm that participants had read and understood the vignette, we included a comprehension check that asked participants about key features of their vignette; correct answers to the comprehension check were required for inclusion in the final data set. At the end of the survey, participants were presented with a debrief statement; for successful completion of a survey, participants were compensated \$0.25. The survey and data collection strategy was approved by the University of British Columbia’s Behavioural Research Ethics Board.

Statistical Analysis

Data were analyzed using SPSS. The sample size calculations assumed that answers on 9-point Likert scales were continuous and, upon confirmation that variances were not statistically different, we compared responses with appropriate statistical tests. The power was set to 80 %, and designed to be sensitive to a Cohen’s $d=0.5$ (medium effect) [58], which detects a mean difference of 1 between groups and assumes a standard deviation of 2 (more than sufficient given the 9-point Likert scale).

Results & Discussion

The results are based upon data from 4,011 unique participants who were presented with a single vignette in one of four experiments: safety, pressure, fairness, and authenticity. Of these participants, 261 were from Canada, and 3,750 were from the United States. The demographics of this sample were similar but not identical to that of the general United States and Canadian populations: 55.6 % of participants were male and 43.9 % were female (biased towards males), and their average age was 30.6 (slightly younger than the general population) [59, 60].

Safety

Any discussion that touches upon the safety of CE necessarily considers the balance between benefits and harms. The most optimistic scenarios discussed in the literature paint a picture of hypothetical enhancements that provide benefit with essentially no prospect of detriment [61], while dystopian projections evoke images of people injured in pursuit of CE [19, 62]. Our aim was not to determine whether the safety of CE was of concern to the public; we take that as a given. Rather, our objective was to use the ability of individuals to carry out an internal calculation regarding the trade-off between harms and benefits as a means of exploring their overall normative stance towards the use of CE under a variety of conditions. In order to do so, we kept the harms described in each of six contrastive vignettes constant while systematically manipulating either the perceived benefit or the specific technology for CE.

In a pilot study, participants were asked about their assessments of the risk-benefit profile of five different side effects (facial redness, insomnia, migraine, hearing loss, and vision loss) in an enhancement scenario (data not shown). The objective was to identify a side-effect that was sufficiently bothersome that participants would not conclude that it was *usually* worth the risk, but not so severe as to lead people to conclude that it was *rarely* worth the risk. The side effect ‘occasional insomnia’ best satisfied these criteria.

The first set of experiments explored the question of whether people discern the difference between *enhancement* and *restoration*, where enhancement is the use of CE by individuals who are fully capable, and restoration is the use of CE by people whose cognitive capacities may be slightly diminished but remain

within the normal range [63]. Bordering on the terrain of the traditional treatment-enhancement distinction [64, 65], our hypothesis was that people would be more tolerant of side effects when they arise in the course of restoration than enhancement. To test this hypothesis directly, we randomly assigned participants ($n=252$) to one of two vignettes that described a 42-year-old magazine editor whose cognitive abilities were either normal (the ‘enhancement’ condition) or slightly degraded but within the normal range for her age (the ‘restoration’ condition). The enhancement was a pill that improved attention, and had the occasional side effect of modest insomnia. Participants were asked to provide their assessment of whether the treatment (‘enhancement’ or ‘restoration’) was worth the risk, with the primary outcome measure being the participants’ ratings on a 9-point Likert scale with anchors stating ‘not at all worth the risk’ and ‘entirely worth the risk.’ Participants reported that it was significantly more worthwhile for the individual described in the vignette to take on the risk of mild insomnia when restoring as opposed to enhancing using a pill ($t(250)=2.689$, $p<0.01$, Fig. 1a, PCE).

If public perceptions of the balance between benefits and harms are indeed modulated by the difference between enhancement and restoration, the specific *modality* of the enhancement should not dictate the results: people should feel that the benefit of using the agent is greater when restoring than when enhancing irrespective of the enhancement technique being employed. To address this issue, a different group of individuals ($n=255$) were randomly assigned to one of two vignettes that were identical in every respect to those described in the previous experiment except that the enhancement was an electrical device whose description was essentially that of tDCS. We chose tDCS for this experiment because in many ways it is similar to pills for CE: the evidence for its ability to enhance a variety of cognitive functions is relatively compelling, and the side effects appear to be modest [66]. Once again, participants felt that CE was significantly more worth the risk when the outcome was restoration rather than enhancement ($t(253)=2.620$, $p<0.01$, Fig. 1a, tDCS). There was no difference between assessments as to the proper balance between risk and reward with tDCS versus that of pills for enhancement ($t(254)=0.305$, $p=0.76$, Fig. 1a) or restoration ($t(249)=0.463$, $p=0.64$, Fig. 1a). Thus, these first two experiments demonstrate that the public reliably discerns the difference between

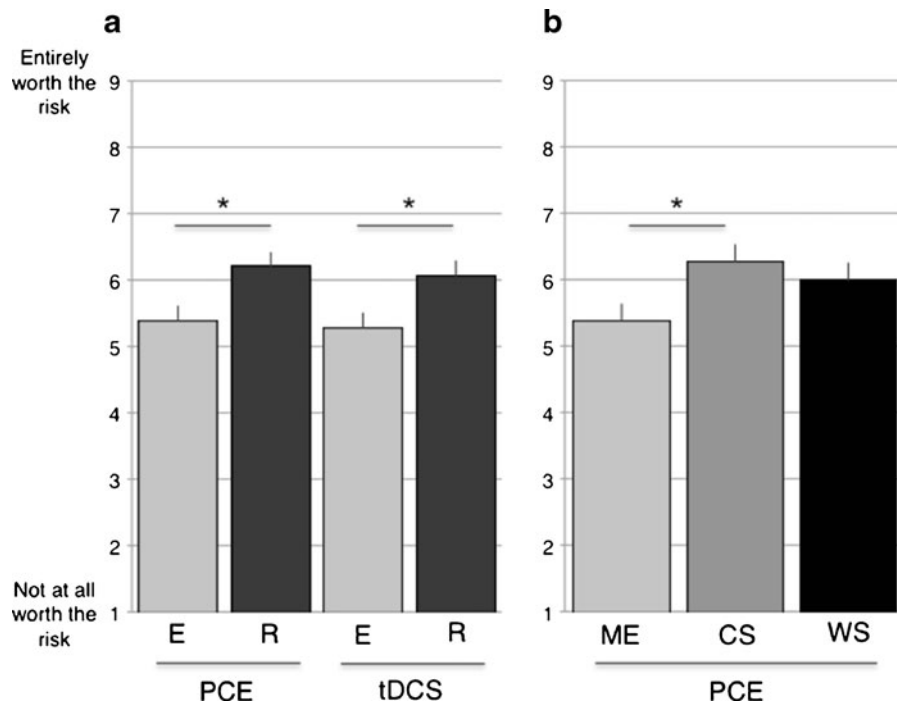


Fig. 1 Safety: public attitudes about the balance of risk and reward in cognitive enhancement **a** Assessments of risk versus reward when enhancing (E) or restoring (R) using either pharmacological cognitive enhancement (PCE) or transcranial direct

current stimulation (tDCS) **b** Assessments of risk versus reward when the individual enhancing with PCE is either a magazine editor (ME), cancer scientist (CS), or weapons scientist (WS) (* $p < 0.01$)

restoration and enhancement, and does so to a similar degree with two distinct modalities.

Prospect theory [67] may bear on participants' judgments about enhancement and restoration: participants may frame enhancement as a gain and restoration as avoiding a loss. In order to investigate this potential framing effect, we ran a follow-up experiment. After responding to vignettes that were identical to the previous enhancement and restoration conditions, participants ($n=161$) answered a question asking whether they thought that the pill provided Susan with the opportunity to gain something or to avoid the loss of something. Significantly more participants in the enhancement condition viewed the pill as a gain of something (70/83) than did participants in the restoration condition (54/78), ($t(159)=2.300$, $p < 0.05$). However it is worth noting that in both the restoration and the enhancement conditions, the majority of participants viewed the pill as providing a gain of something. These data suggest that framing effects may be responsible, in part, for differing attitudes towards the use of CE for restoration and enhancement, but are unlikely to fully account for the observed effects.

Finally, we utilized the safety vignette to explore the question of whether the calculus regarding the balance between risk and benefit changes when the enhancement is carried out for the common good [68]. To test the hypothesis that societal benefit affects the tolerability of enhancements, participants ($n=262$) were randomly assigned to one of two vignettes, which were identical to the first experiment in this series except that the individual taking the enhancement was a scientist rather than a magazine editor. We further manipulated the prosocial nature of the work by describing the individual as either a cancer scientist (highly prosocial) or a weapons scientist (less clearly prosocial). Consistent with the hypothesis that attitudes towards the risks and benefits of enhancement are modulated by the prosocial nature of an individual's occupation, participants considered the prospect of a cancer scientist enhancing as significantly more worth the risk than when the individual was identified as a magazine editor ($t(264)=2.921$, $p < 0.01$, Fig. 1b). In contrast, participants did not consider the prospect of a weapons scientist enhancing as significantly more worth the risk than when the individual was identified

as a magazine editor ($t(246)=1.904$, $p=0.058$, Fig. 1b). There was no significant difference in the risk assessments when the individual enhancing was a cancer scientist or a weapons scientist ($t(250)=0.915$, $p=0.361$, Fig. 1b). This result may be confounded by the possibility that participants perceive the scientists in other ways, for example as the cancer scientist having greater medical knowledge; further studies are required to clarify these issues.

Pressure

Pressure to enhance is essentially about the power of social norms to modify attitudes towards, and use of, CEs by the public. In approaching this topic experimentally, we felt it important to mirror the types of situations that appear in the real world. In so doing, we found it helpful to distinguish between two forms of pressure that appear to be on the rise. In one of these, which we term *soft societal pressure* (sSP), pressure to enhance arises from such quotidian influences as demands of the workplace or expectations of society at large, but is absent specific knowledge indicating that peers are enhancing. This is contrasted with *soft peer pressure* (sPP), in which these same societal influences exist but are buttressed by a form of implicit social endorsement in which one has specific knowledge that peers are enhancing, albeit no explicit pressure from peers to join in. The distinction between sSP and sPP was intentionally designed to be subtle, capturing the range of situations that are often described as currently occurring on college campuses and may already be emerging in the workplace. Our primary hypothesis was that people would view sPP to use CE as more bothersome than sSP. Our secondary hypothesis was that the bothersome nature of pressure to enhance might be affected by the *modality* of enhancement.

To test these hypotheses, participants ($n=1,219$) were randomly assigned to one of six vignettes, arranged in three pairs that differed only in the modality of enhancement employed. In all vignettes, participants were asked to imagine that they worked as a paralegal in a law firm and that their ability to remember things was important. The vignettes clearly stated that performance in the previous year had been only moderately good and that as a result, the bonus that they had received was “less than you had hoped.” The vignettes then described a situation in which the individual reads a magazine article about a new memory enhancing technology. The specific technology that is described varies in the three pairs of

vignettes, but all describe CE: in one pair of vignettes the enhancer is a pill, in another the enhancer is tDCS, and in the third the enhancement is in the form of brain fitness software. All are described as equally safe, inexpensive, and effective. The vignette continues by explicitly pointing out that the enhancement technology does not “put knowledge into the brain” but rather makes it easier to retain information. For each modality of enhancement, one version of the vignette describes sSP, in which participants are told that performance reviews are a few months away and “you consider whether to make use of this CE technology”. A second version of the three vignettes described a situation with sPP by adding a sentence in which participants are told that their co-workers have been using this very same form of enhancement and in the previous year they exceeded their performance goals and received a full bonus.

After reading one of the vignettes, all participants were asked an identical series of questions. The first question asked how likely they would be to use the relevant technology if they were the paralegal described in the vignette. There was a significant increase in participants’ likelihood to use CE in the sPP condition compared to the sSP condition for the tDCS modality ($t(274)=2.063$, $p<0.05$), but no difference in likelihood to use for the pill ($t(638)=0.981$, $p=0.327$) or software-based brain-training ($t(300)=-1.351$, $p=0.178$) modalities (Fig. 2, “Likely”). The second question asked participants to rate the degree to which they felt pressure to enhance, given the situation described in the vignette. Essentially an internal control, this question was designed to determine whether participants perceived the intended difference in pressure between sSP and sPP. There was a significant increase in the perceived amount of pressure when it was described as sPP in all three conditions – tDCS ($t(274)=4.217$, $p<0.001$), pill ($t(638)=4.864$, $p<0.001$), and software-based brain-training ($t(300)=2.850$, $p<0.01$) – demonstrating that participants perceived the vignettes as intended (Fig. 2, “Pressure”). The final question probed the bothersome nature of any perceived pressure to enhance. The results demonstrate that sPP was significantly more bothersome than sSP for both the tDCS ($t(274)=3.189$, $p<0.01$) and pill ($t(638)=2.890$, $p<0.01$) modalities, but not for the software-based brain-training modality ($t(300)=1.616$, $p=0.107$). Thus pressure to enhance appears to be more bothersome for some modalities than for others (Fig. 2, “Bothered”). Given the results of our fairness and authenticity experiments, one plausible

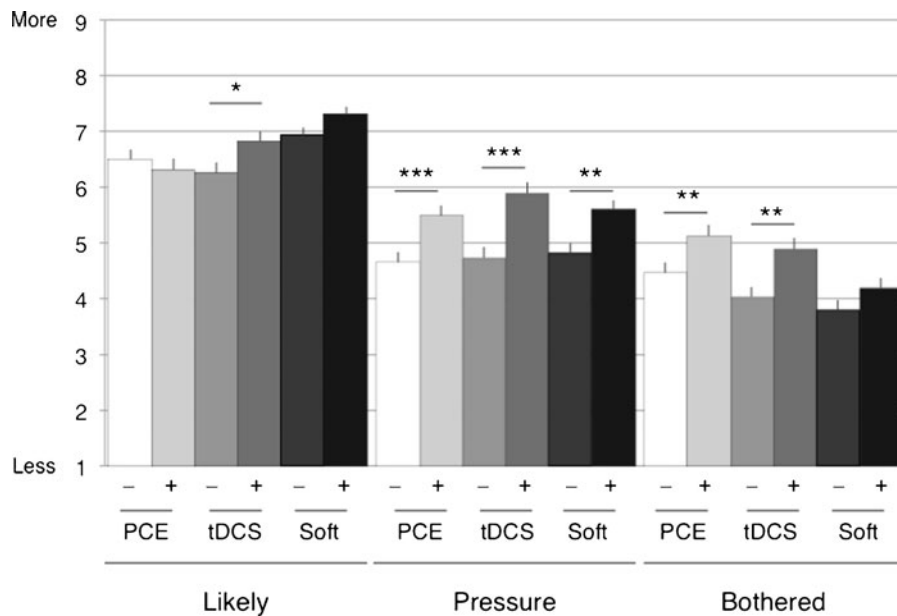


Fig. 2 Pressure: public attitudes about pressure in cognitive enhancement. Assessments of likelihood to use CE (Likely), perception of pressure (Pressure), and bothersome nature of pressure (Bothered) in conditions of soft societal pressure (–) or soft peer pressure (+) with three domains of CE: pharmacological (PCE), transcranial direct current stimulation (tDCS), and brain

fitness software (Soft). Participants reported that they would be more likely to use tDCS in the presence of soft peer pressure, they felt significantly more bothered by soft peer pressure than soft societal pressure, and they were significantly more bothered by soft peer pressure to use PCE and tDCS than by soft societal pressure. (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

explanation for this result may be that the software-based enhancement appeals to effort (based on training), and triggers intuitions about fairness and authenticity that may neutralize the effects of pressure. Another explanation might be that in the case of technological means of enhancement, sPP more clearly represents a transgression of personal autonomy, with the resultant pressure being perceived as more bothersome.

We have suggested that stated preferences are unreliable because of the cognitive biases inherent the participants' answers [43, 44, 46, 69, 70]. While recognizing that the absolute value of the data is unreliable, there is an interesting observation to be made in this particular instance: people generally reported that there was a high likelihood that they would use the enhancement in the context of the workplace. This is all the more striking when viewed in light of the data presented in the experiments on authenticity (below), which suggest that the most socially desirable strategy is to work hard to achieve success rather than to use CE to achieve the same result. Thus, if the answers to our query about likelihood to enhance are skewed by social desirability bias [71–73], the likelihood that people would use CE, at least in the context of the vignette as presented, can be

expected to be even greater. How this might translate into real world use is unknown, but may be taken as evidence to suggest that the likelihood that people will choose to enhance in the workplace is relatively high.

Fairness

A dominant theme that runs through the CE debate is that of *fairness*. The discussion focuses upon distributive justice—the notion that CEs, by virtue of their cost, will be more easily obtained by the wealthy than the poor, and thus will increase the disparity between the “haves” and the “have-nots” [4, 74, 75]. Indeed, data from neuroeconomics suggest that the human cognitive toolkit does not evaluate all forms of inequality equally [76], and at least in the context of contemporary social democracies, differences in wealth are generally tolerated so long as they do not violate perceptions of what is fair. Moreover, the data suggests that people generally endorse at least some form of meritocracy [77], viewing unequal distribution of goods as more acceptable when they involve differences in *effort* than when they arise as a result of *luck* [78, 79]. CE tends to evoke objections based upon fairness violations for at least two reasons.

First, the source of funds used to purchase CE may be the result of either effort or luck. Second, there is a widespread (if generally erroneous) perception that enhancement allows for achievement without effort, playing into the very sentiments that vilify luck and reward hard work. We designed experiments to directly address both of these issues.

To test the hypotheses that (a) the source of one's wealth and (b) achievement without effort represent a meaningful fairness violation for the public in the debate over CE, participants ($n=535$) were randomly assigned to one of four vignettes that described two young men who are studying for a standardized exam. Both are members of a study group, and they read about a CE pill that is moderately expensive (\$1200) such that only one of the two individuals—the wealthier one—is able to afford the enhancement. The contrastive features of the vignettes are the source of wealth and the effort required to enhance successfully. For wealth: in the first and second vignettes, the wealthier individual is able to afford the pills because of family wealth, while in the third and fourth vignettes, he is able to afford it because he has saved money from his summer job. For effort: in the first and third vignettes, the pill “makes the hard work of studying feel simple and effortless”, while in the second and fourth vignettes, the pill “improves test performance only if users are diligent and use the extra waking hours to study.” Participants are then asked about the fairness of one individual being able to afford the enhancement while the other was not.

We analyzed the fairness ratings using a two-way, between-subjects ANOVA. This revealed a main effect of effort ($F(1, 535)=7.203, p<0.01$), and a main effect of wealth ($F(1, 525)=16.643, p<0.001$). Importantly, we observed an interaction between effort and wealth ($F(1, 535)=4.949, p<0.05$). Due to this, we performed a one-way, between-subjects ANOVA ($F(3, 534)=9.594, p<0.001$) to identify the specific differences between the four groups: (1) family-wealth, no-effort; (2) family-wealth, effort; (3) summer-work, no-effort; (4) summer-work, effort. Post hoc comparisons using the Fisher LSD test revealed that the summer-work, effort condition was rated significantly more fair than any of the other three ($p<0.001$), and that these other three were not significantly different from each other ($p=0.748, p=0.190, p=0.321$, Fig. 3).

Remarkably, when the enhancement was obtained through family wealth, describing the enhancement as effective only if the individual worked hard did not

change participants' judgments of fairness. Moreover, when the enhancement made hard work feel effortless, obtaining the enhancement through summer work did not change participants' judgments of fairness. Only when both the source of wealth *and* the enhancement involved hard work was the inequity rated as significantly more fair than in the other vignettes (Fig. 3). Thus, it seems that moral sentiments about fairness are sensitive to any hint that there may be a reduction in hard work (be it with respect to sources of wealth or the means by which one achieves success). Presumably, this obliterates the sense that the student's advantage could be fully traced to individual merit. That is, people's perceptions of what makes for a meritocratic scenario seem exceptionally *fragile*. The role of hard work in moral judgements about CE is further explored in the next set of experiments on authenticity.

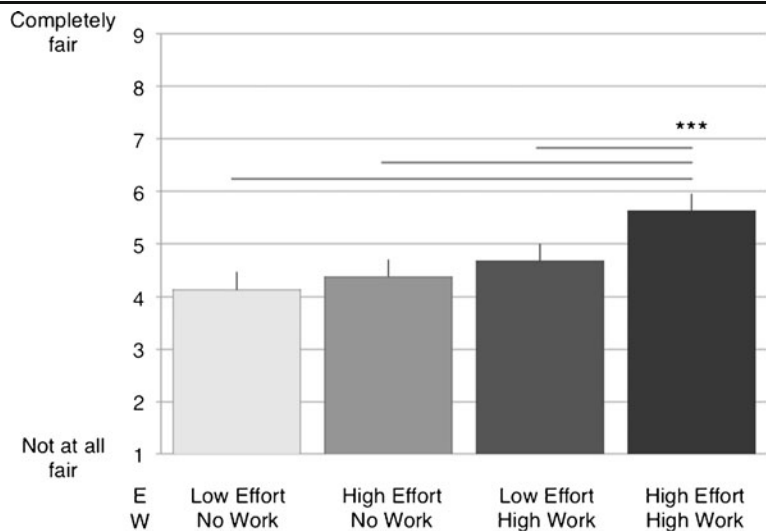
Authenticity

The essence of the argument regarding authenticity is that using technology to enhance represents a shortcut to success, and thus, achievements obtained using CE are not fully authentic [5, 6, 74, 80, 81]. The debate over the veracity of this claim seems to attract much in the way of thoughtful consideration, but what concerns us in this investigation is less the assessments of experts than the perspective of the public.

In principle, shortcuts to success with CE use could manifest in one of two ways. The first is that CE might improve productivity, allowing one to work more efficiently per unit time. In this view, people who use CE might complete tasks in a shorter period of time, or produce more in the same amount of time. The second way that CE use might be evident is not a shortcut at all: CE might facilitate cognitive perseverance, allowing one to work longer without mental fatigue. The unifying feature is that enhancement allows individuals to over-achieve by making the task appear easier: when productivity is increased, less effort is required to achieve the same objective, and when cognitive perseverance is enhanced, more time may be required but fatigue is lessened. In order to explore public attitudes towards authenticity in the context of CE use, we developed vignettes that systematically modified time and effort independently, corresponding to these two strategies for CE functionality.

In the first group of vignettes, we modulated productivity while keeping time constant. Participants ($n=348$)

Fig. 3 Fairness: public attitudes about the fairness of unequal access to cognitive enhancement. Assessments of the fairness of unequal distribution of a pharmacological cognitive enhancement when the enhancement (E) either makes studying feel effortless (Low Effort) or requires hard work (High Effort), and the \$1200 (W) to obtain the enhancement is acquired by family wealth (No Work) or earned via a summer job (High Work) (***) $p < 0.001$)



were randomly assigned to one of three vignettes, each of which begins with an identical description of an engineer who is being considered for promotion when he is assigned a new project. The task is demanding, and it is explicitly stated that he finds it useful to “keep lots of information in his head and work through mental fatigue.” The vignette recounts how he is having difficulty completing the task in his normal 8-hour day; it seems he needs 10 h to get everything done, but he carools to work and therefore working longer than 8 h is not practical. He reads about a CE pill that allows “people to keep more information in their brains than they would otherwise,” essentially an enhancement that fosters greater productivity. The three vignettes then diverge. In the Unenhanced/Fail vignette, he does not take the pill and continues to work for 8 h exactly as before but does not complete the task, and receives a mediocre performance review. In the Unenhanced/Success vignette, he once again does not take the pill but rather musters internal resources to work hard and complete the task in his 8-hour day, and receives a glowing performance review. In the Enhanced/Success vignette, he takes the pill and comfortably completes the task in his 8-hour day, receiving a glowing performance review. Irrespective of which version of the vignette they read, all participants were then asked to provide a rating for how authentic his performance was, and how worthy he was of a promotion.

As can be seen in Fig. 4a, in the Unenhanced/Fail vignette, participants rated the authenticity of the engineer’s performance as no different than that described in the Unenhanced/Success vignette ($t(229)=1.397$, $p=0.164$).

In contrast, in the Enhanced/Success vignette, his performance was viewed as significantly less authentic than either the Unenhanced/Fail ($t(227)=-4.975$, $p<0.001$) or Unenhanced/Success ($t(234)=-6.059$, $p<0.001$) vignettes. Thus, participants perceived that the authenticity of his performance when using the enhancement was diminished irrespective of success. At the same time, participants generally attributed worthiness of promotion to success (Fig. 4b), finding him significantly more worthy of promotion in the Enhanced/Success and Unenhanced/Success vignettes than in the Unenhanced/Fail vignettes ($t(227)=6.210$, $p<0.001$; $t(229)=9.831$, $p<0.001$, respectively).

In order to explore the impact of time while keeping productivity constant, we randomly assigned another group of participants ($n=350$) to one of three vignettes that were identical to those described above, except that the pill is now described as allowing “people to work longer than they would otherwise without mental fatigue,” invoking cognitive perseverance as the outcome of the CE. To allow for the extended workday, the hypothetical worker finds a colleague who can give him a ride home later in the day, allowing him to work the full 10 h required to complete the job. Both effort and outcome in Unenhanced/Fail, Unenhanced/Success, and Enhanced/Success vignettes were identical to that described previously, except that he spends 10 h rather than 8 h on the task. Note that in the Unenhanced/Success vignette, both effort and time are modulated. Remarkably, the results when time is increased are essentially indistinguishable to those seen when time was held constant, with the exception

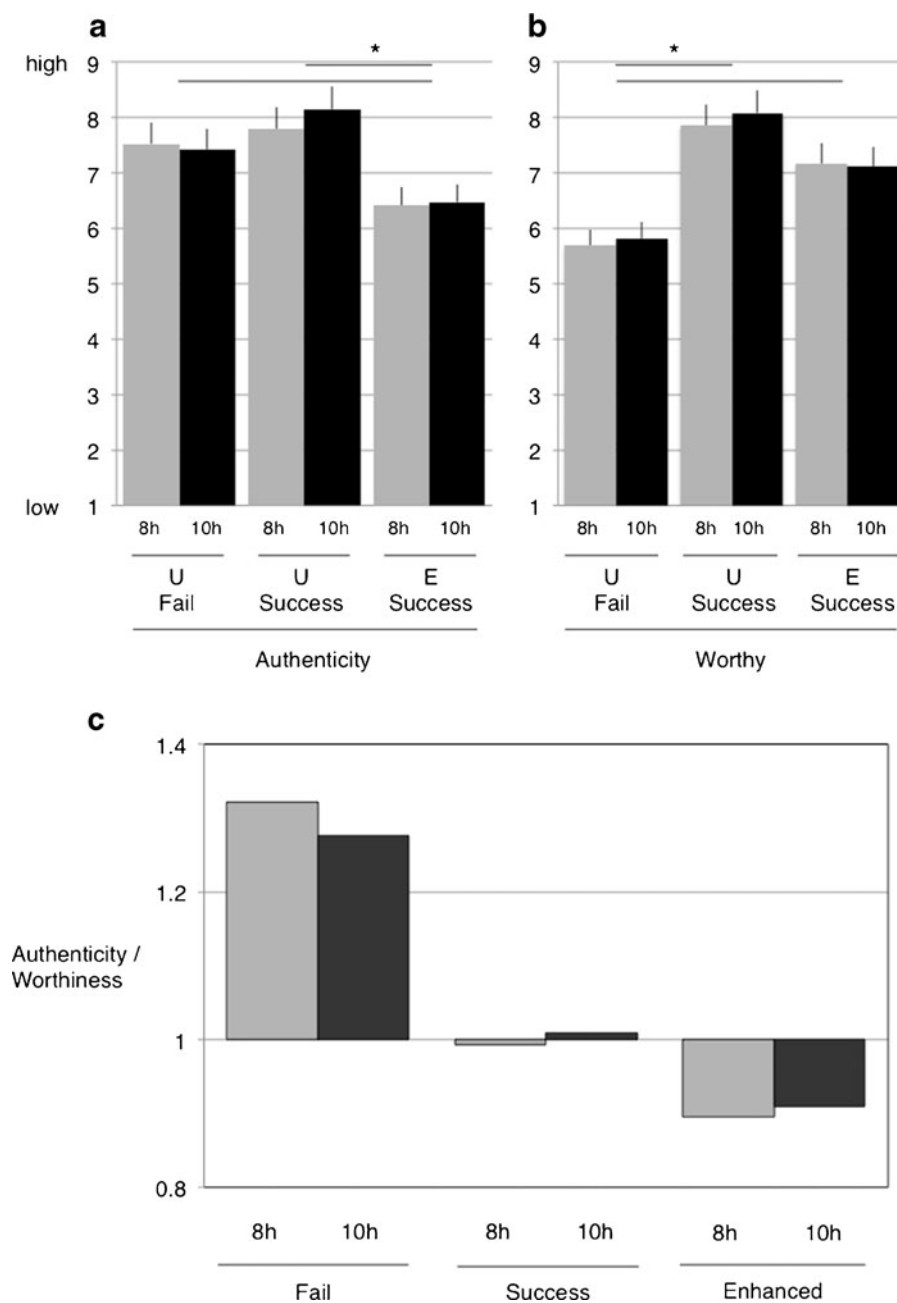


Fig. 4 Authenticity & Worthiness: public attitudes toward authenticity and worthiness in cognitive enhancement. **a** & **b** Assessments of the authenticity of achievement (A) and worthiness of promotion (B) when the individual is enhanced (E) or unenhanced (U), and fails (Fail) or succeeds (Success) in a normal 8-hour workday (8) or an extended 10-hour workday (10) (* $p < 0.001$). The horizontal lines above the paired bars

indicate a significant difference between the measure for 8 h in both conditions and the measure for 10 h in both conditions. Although not shown in the figure, there was a significant difference between the 10 h Unenhanced-Fail and 10 h Unenhanced-Success conditions ($p < 0.05$) **c** Ratio assessments of authenticity divided by worthiness across Fail, Success, and Enhanced situations

that now the authenticity of the individual in the Unenhanced/Success vignette is rated as significantly

greater than that in the Unenhanced/Fail vignette ($t(232) = 3.858, p < 0.001$, Fig. 4b).

The relationship between participants' assessments of authenticity and their ratings of worthiness for promotion can best be seen in Fig. 4c, where the ratio of the two measures are plotted. What is evident is that authenticity ratings are greater than worthiness ratings in the Unenhanced/Fail vignette, the ratings of both measures are essentially equal in the Unenhanced/Success vignette, and that worthiness ratings outstrip authenticity in the Enhanced/Success vignettes. The substantial variance of these two parameters across vignettes reveals underlying sentiments about the relationship between authenticity and worthiness in the context of the CE debate.

Taken together, these results demonstrate that the public is fully cognizant of the key features of the authenticity concern: whenever the individual enhances, his performance is rated as significantly less authentic than when he does not, including situations in which he fails at the task. The crucial observation is that diminished authenticity does not fully translate into diminished worthiness. Even as they acknowledge that authenticity of effort has been compromised, participants felt that enhanced individuals who succeeded at the task were significantly more worthy of promotion than those who failed. At the same time, participants felt that he was significantly more worthy when he was successful without enhancements than when he enhanced. In the discussion that follows, we shall explore more fully the biopolitical and philosophical implications that these data have for the CE debate in general, and for policy in particular.

The Public is Biopolitically Moderate

Taken as a whole, the data suggest that the public endorses a view that is biopolitically moderate. Observable throughout the data set, this position was best exemplified by those experiments that explored public attitudes toward the safety of CE. The fact that the responses fell in the middle of the scale is not particularly informative because of the ease with which stated preferences might be manipulated by key features of the vignette. Indeed, the side effect of occasional insomnia was *chosen* in pilot studies to evoke views that rested in the middle of the scale. More illuminating was the distribution of responses; if the results were based upon data that were clustered at the poles but averaged in the middle, our sample might reasonably be interpreted as providing support for both transhumanist and bioconservative

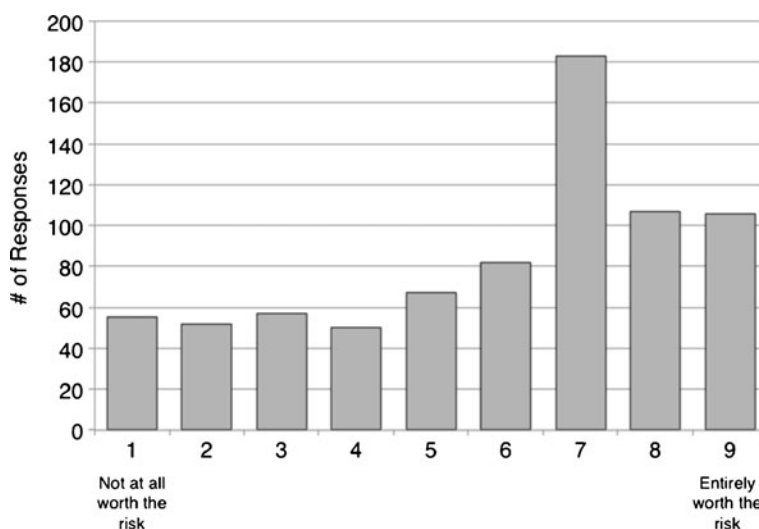
views. Indeed, if one were sensitive to the frequency and volume of the rhetoric emerging from the poles of the debate [19, 82–84], one might imagine that the populace is biopolitically polarized. In contrast, the data show a unimodal distribution (Fig. 5), with the majority of participants clustered in the biopolitically moderate middle.

The Public Endorses Meritocratic Principles Yet Values Effort

Central to egalitarian values is the notion of a meritocratic society, in which individuals are rewarded for their achievements rather than their bloodlines [77]. In this view, stratification of goods in society is acceptable so long as those who have attained advantages earned them in a manner that is perceived as being fair [79]. Though a genuine meritocracy is more myth than reality today [85, 86], people appear to view an equitable, meritocratic distribution of wealth as ideal [87]. That the use of an enhancement besmirches considerations of merit has generally been the platform upon which bioconservatives have argued that “the merit of disciplined and dedicated striving—though not the deepest basis of our objection to biotechnological shortcuts, is surely pertinent” [19]. Liberal philosophers have generally been successful in discounting this version of the authenticity concern, pointing out that the Calvinist notion of suffering as a mark of worthiness is misguided [80]. Notably, this view makes room for value to be ascribed to hard work under some circumstances, but argues that in the case of CE, the evidence is not compelling. What we are left with in such instances is something very much akin to a consequentialist stance toward CE in which the results of our activities are at least as important as the way they are attained [88]. What does the public think?

The results of our Authenticity experiment provide some answers. Participants endorsed aspects of a results-oriented stance, whether consequentialist or not [89], viewing success in the task as the key feature for determining worthiness: the protagonist was consistently judged as less worthy of promotion whenever he was unsuccessful in completing the task, irrespective of whether he appeared slightly indolent in the 8-hour version of the vignette, or more hard working but still incapable in the 10 h version. Moreover, he was deemed significantly more worthy in the vignettes in which he succeeded than in those in which he failed irrespective of

Fig. 5 Histogram of public sentiments towards safety, with the x-axis indicating the individual responses on the Likert scale and the y-axis indicating the number of responses to all 6 safety vignettes. Responses are distributed unimodally



whether he enhanced or not. As if to underscore this point, in the enhancement vignette, participants explicitly recognized the inauthenticity inherent in the achievement, yet seemed to agree that ends are more important than means. These are among the most relevant data for understanding the public's attitudes about the morality of CE: the public imparts value to success regardless of whether one enhances or not, and people explicitly recognize that enhancement diminishes authenticity. Endorsement of this particular version of meritocratic achievement—success as a primary determinant of worthiness—represents a compelling argument that there exists reasonably strong public support for the use of CE.

However, to leave the matter there would do a disservice to the data, for Kass' frequently derided bioconservative position that hard work determines merit also appears to garner support [19]. While the public might find success to be a primary determinant of worthiness, successful individuals who worked hard but did not enhance were viewed as significantly worthier still (or, reversing matters, one might say that enhancement significantly decreased assessments of merit, so long as the bottom line was success). Thus, while public attitudes do not appear to strongly condemn enhancement, they remain sufficiently sensitive to the value of authentic achievement as to consider it more meritorious.

The Public Appears Morally Reasonable

Are people's judgments about the moral propriety of CE reliably discerning? Is the public stubbornly unwavering,

appropriately responsive to reasons, or overly sensitive to irrelevant features? In contemporary moral psychology, there exists a healthy debate over the means by which people arrive at moral judgments. Traditionally it was thought that we *reason* about moral issues, weighing the salient evidence and changing our minds in response to relevant reasons [90, 91]. Haidt's influential critique of rationalist moral psychology—pointing out the influence of automatic, emotional, effortless, and unconscious cognitive work [92], raised substantive questions about the role of reasoning in moral judgment, but more recent work has reopened the debate [93–95].

It seems reasonable to suggest that our confidence in the value of public attitudes towards CE might be affected by the degree to which their judgments are flexible enough to respond to reasonable arguments in the debate. Judgments need not necessarily be explicitly reflective to qualify as reasonable—we do not expect nor require the public to exhibit the deliberative logic of philosophical analysis—but rather that their thinking and judgments (whether intuitive or deliberative) [69] should be, to some considerable degree, flexibly responsive to reasons.

Given how trenchantly partisan the views of the lay public are thought to be, one might suspect that they might exhibit the sort of stubbornness thought to be characteristic of moral judgment [96–99]. Indeed, this assumption—that people hold such fierce judgments about CE that they maintain them even in the face of satisfactory reasons—is apparent in the debate about CE [100]. The most illuminating data on this point derive from our experiments investigating participants'

attitudes about fairness. The vignette described a situation in which two individuals had unequal access to funds to purchase CE, with two additional fairness violations that acted as modifiers: inherited wealth or lack of effort in the usage of CE. If the public were unresponsive to reasons, we would expect judgments of fairness to be invariant regardless of the presence or lack of supporting moral reasons. Instead, the public's attitudes appear to be flexible: as a group, they were sensitive to the presence of the modifiers, but when both were removed, participants' assessments of the fairness of the situation changed significantly. Data derived from the other experiments support this position. In the safety experiment, people were responsive to the balance between benefits and harms; in the pressure experiment, people were sensitive to the difference between societal and peer pressure; and in the authenticity experiment, people exhibited flexible normative positions, adopting a utilitarian stance for questions of worthiness while ascribing value to virtue in considering authenticity. Taken together, these data suggest that the public is responsive to salient moral reasons.

Sensitivity to reasons is a necessary but not sufficient criterion for claiming that the public is morally reasonable. People's moral judgments must be sensitive to relevant factors *and* insensitive to irrelevant factors. If people are manipulated by impertinent variables, the consistency of their moral reasoning is drawn into question. In order to test participants' sensitivity to an obviously irrelevant manipulation, we replicated our Safety PCE enhancement and restoration conditions, but changed the protagonist's gender (from Susan to Steven) in paired contrastive vignettes. This irrelevant change did not affect the results. In the enhancement condition, Susan vs Steven: $t(147) = -1.368, p = 0.173$; in the restoration condition, Susan vs Steven: $t(121) = -0.636, p = 0.526$; thus we conclude that at least under these conditions, public attitudes towards CE are not sensitive to an irrelevant factor.

The history of the debate over CE has been one in which expert opinion has dominated and public opinion has been relegated to the back seat, if indeed a role has been considered at all [101, 102]. We suggest that empirical data demonstrating that the public's judgments are sensitive to the reasons commonly discussed by experts provides compelling evidence that public attitudes, or even the public themselves, should be included in the development of future policy.

Data Should Inform Future Policy

We do not suggest that public policy should slavishly follow public attitudes towards CE. The “*is*” of public sentiment is not the sole concern of the “*ought*” of policy prescription. We do, however, make a normative claim: that we should craft regulation so that it *reasonably aligns* with public attitudes. In a liberal democratic society, there are strong theoretical reasons for including public attitudes in regulatory policy [36–38, 103, 104]. Of equal importance is the observation that if regulation does not approximate the views of the public, myriad policy inefficiencies arise [105–109]. Primary among these with regard to CE should be consideration of the harms that might arise if policy encourages the formation of illegal markets [110]. Current policies with respect to pharmaceuticals that are used for the treatment of ADHD appear to have already created such black markets, with no metrics available with regard to harms [111, 112]. Equally relevant are issues of workplace pressures to use CE, and the need to balance demands for increased productivity with those of individual autonomy [113].

Our data represent some of the first instances in which quantitative methods have been used to obtain substantive insight into public attitudes toward the moral propriety of CE—precisely the type of information that is required to guide the development of sound policy. Although further studies are required to justify strong recommendations, certain broad observations are worth considering. The most salient among these is that the public recognizes issues such as the nature of pressure to enhance and the authenticity of achievement under the influence of CE, but they do not reject CE outright. The public was moderate in their endorsement of CE; there was essentially no evidence for widespread support of radical enhancement, but moral stances often associated with the bioconservative agenda, in particular the value of hard work as a measure of character, received more than passing sanction. Overall, the public appears to be cautiously accepting of CE, even as they recognize the potential perils.

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References

- Beddington, John, Cary L. Cooper, John Field, Usha Goswami, Felicia A. Huppert, Rachel Jenkins, Hannah S. Jones, Tom B.L. Kirkwood, Barbara J. Sahakian, and Sandy M. Thomas. 2008. The mental wealth of nations. *Nature* 455: 1057–1060.
- Hughes, James. 2009. TechnoProgressive biopolitics and human enhancement. In *Progress in bioethics*, eds. J. Moreno and S. Berger, 163–188. Cambridge: MIT Press.
- Reiner, P.B. 2013. The biopolitics of cognitive enhancement. In *Cognitive Enhancement: an interdisciplinary perspective*. Dordrecht: Springer Science + Business Media.
- Hyman, Steven E. 2011. Cognitive enhancement: Promises and perils. *Neuron* 69: 595–598. doi:10.1016/j.neuron.2011.02.012.
- Farah, Martha J., Judy Illes, Robert Cook-Deegan, Howard Gardner, Eric Kandel, Patricia King, Eric Parens, Barbara Sahakian, and Paul Root Wolpe. 2004. Neurocognitive enhancement: What can we do and what should we do? *Nature Reviews Neuroscience* 5: 421–425. doi:10.1038/nm1390.
- Greely, Henry, Barbara Sahakian, John Harris, Ronald C. Kessler, Michael Gazzaniga, Philip Campbell, and Martha J. Farah. 2008. Towards responsible use of cognitive-enhancing drugs by the healthy. *Nature* 456: 702–705. doi:10.1038/456702a. Nature Publishing Group.
- Levy, Neil. 2007. *Neuroethics: Challenges for the 21st century*. Cambridge: Cambridge University Press.
- O'Connor, Cliodhna, Geraint Rees, and Helene Joffe. 2012. Neuroscience in the public sphere. *Neuron* 74: 220–226. doi:10.1016/j.neuron.2012.04.004.
- Allport, Gordon. 1935. Attitudes. In *A handbook of social psychology*, 798–844. Worcester: Clark University Press.
- Albarracin, Dolores, Blair T Johnson, and Mark P Zanna. 2005. *The handbook of attitudes*. Mahwah: Lawrence Erlbaum Associates Publishers.
- Eagly, Alice H, and Shelly Chaiken. 1993. *Psychology of attitudes*. Orlando: Harcourt Brace Jovanovich College Publishers.
- Taylor, Charles. 1991. *The malaise of modernity*. Toronto: House of Anansi Press Ltd.
- Bostrom, Nick, and Rebecca Roache. 2011. Smart policy: cognitive enhancement in the public interest. In *Enhancing Human Capabilities*, eds. Julian Savulescu, Ruud ter Meulen, Guy Kahane, 138–152. Oxford: Wiley-Blackwell.
- Greely, Henry T. 2010. Of nails and hammers: Human biological enhancement and U.S. policy tools. In *Enhancing Human Capacities*, eds. Julian Savulescu, Ruud ter Meulen, Guy Kahane, 503–520. Oxford: Wiley-Blackwell.
- Schermer, Maartje, Ineke Bolt, Reinoud Jongh, and Berend Olivier. 2009. The future of psychopharmacological enhancements: Expectations and policies. *Neuroethics* 2: 75–87. doi:10.1007/s12152-009-9032-1.
- Lucke, Jayne, and Brad Partridge. 2013. Towards a smart population: A public health framework for cognitive enhancement. *Neuroethics*. 6:419–427. doi: 10.1007/s12152-012-9167-3.
- Dubljevic, Veljko. 2012. Toward a legitimate public policy on cognition-enhancement drugs. *AJOB Neuroscience* 3: 29–33. doi:10.1080/21507740.2012.700681.
- Lin, P., and F. Allhoff. 2008. Against unrestricted human enhancement. *Journal of Evolution & Technology* 18: 35.
- The President's Council on Bioethics. 2003. Beyond therapy: Biotechnology and the pursuit of happiness. Washington: The President's Council on Bioethics.
- British Medical Association. 2007. *Boosting your brainpower: Ethical aspects of cognitive enhancements. A discussion paper from the British Medical Association*. London: British Medical Association.
- Larrieviere, D., M.A. Williams, M. Rizzo, and R.J. Bonnie. 2009. Responding to requests from adult patients for neuroenhancements: Guidance of the Ethics, Law and Humanities Committee. *Neurology* 73: 1406–1412.
- Cote, Marie-Claude. 2009. *Psychotropic drugs and expanded uses: An ethical perspective*. Quebec City: Commission de l'éthique de la science et de la technologie.
- Academy of Medical Sciences, the British Academy, the Royal Academy of Engineering and the Royal Society. 2012. *Human enhancement and the future of work*. London: Academy of Medical Sciences.
- Nuffield Council on Bioethics. 2013. *Novel neurotechnologies: Intervening in the brain*. Swindon: Nuffield Council on Bioethics.
- Slob, Marjan, Peter Raeymaekers, and Karin Rondia. 2005. Meeting of minds: European citizen's deliberation on brain science. London: Meeting of Minds Partner Consortium.
- Maher, Brendan. 2008. Poll results: Look who's doping. *Nature* 452: 674–675. doi:10.1038/452674a.
- Banjo, Opeyemi C., Roland Nadler, and Peter B. Reiner. 2010. Physician attitudes towards pharmacological cognitive enhancement: Safety concerns are paramount. *PLoS ONE* 5(12): e14322. doi:10.1371/journal.pone.0014322.t003.
- Forlini, C., and E. Racine. 2012. Stakeholder perspectives and reactions to "academic" cognitive enhancement: Unsuspected meaning of ambivalence and analogies. *Public Understanding of Science* 21: 606–625. doi:10.1177/0963662510385062.
- Hotze, Timothy D., Kavita Shah, Emily E. Anderson, and Matthew K. Wynia. 2011. "Doctor, would you prescribe a pill to help me ... ?" a national survey of physicians on using medicine for human enhancement. *The American Journal of Bioethics* 11: 3–13. doi:10.1080/15265161.2011.534957.
- Franke, Andreas G., Christiana Bagusat, Pavel Dietz, Isabell Hoffmann, Perikles Simon, Rolf Ulrich, and Klaus Lieb. 2013. Use of illicit and prescription drugs for cognitive or mood enhancement among surgeons. *BMC Medicine* 11: 102. doi:10.1186/1741-7015-11-102.
- Bell, Stephanie, Brad Partridge, Jayne Lucke, and Wayne Hall. 2013. Australian university students' attitudes towards the acceptability and regulation of pharmaceuticals to improve academic performance. *Neuroethics* 6: 197–205. doi:10.1007/s12152-012-9153-9. Springer.
- Forlini, Cynthia, and Eric Racine. 2012. Added stakeholders, added Value(s) to the cognitive enhancement debate: Are academic discourse and professional policies sidestepping values of stakeholders? *AJOB Primary Research* 3: 33–47. doi:10.1080/21507716.2011.645116. Taylor & Francis Group.
- Franke, Andreas G., Caroline Bonertz, Michaela Christmann, Stefan Engeser, and Klaus Lieb. 2012. Attitudes toward cognitive enhancement in users and nonusers of stimulants for cognitive enhancement: A pilot study. *AJOB Primary Research* 3: 48–57. doi:10.1080/21507716.2011.608411.

34. Sabini, John, and John Monterosso. 2005. Judgments of the fairness of using performance enhancing drugs. *Ethics & Behavior* 15: 81–94. doi:10.1207/s15327019eb1501_6.
35. Sattler, Sebastian, Carsten Sauer, Guido Mehlkop, and Peter Graeff. 2013. The rational for consuming cognitive enhancement drugs in university students and teachers. *PLoS ONE* 8(7): 1–10.
36. Pillow, David R., Lavelda J. Naylor, and Glenn P. Malone. 2012. Beliefs regarding stimulant medication effects among college students with a history of past or current usage. *Journal of Attention Disorders*. doi:10.1177/1087054712459755.
37. Bolt, Ineke, and Maartje Schermer. 2009. Psychopharmaceutical enhancers: Enhancing identity? *Neuroethics* 2: 103–111. doi:10.1007/s12152-008-9031-7.
38. Singh, Ilna. 2012. *VOICES Study: Final Report*. London, UK.
39. Sarewitz, Daniel. 2010. World view: Not by experts alone. *Nature* 466: 688–688. doi:10.1038/466688a.
40. Schicktanz, Silke, Mark Schweda, and Brian Wynne. 2012. The ethics of ‘public understanding of ethics’—why and how bioethics expertise should include public and patients’ voices. *Medicine, Health Care, and Philosophy* 15: 129–139. doi:10.1007/s11019-011-9321-4.
41. Salloch, Sabine, Jochen Vollmann, and Jan Schildmann. 2013. Ethics by opinion poll? The functions of attitudes research for normative deliberations in medical ethics. *Journal of Medical Ethics*. doi:10.1136/medethics-2012-101253.
42. Knobe, Joshua, and Shaun Nichols. 2008. *Experimental philosophy*. New York: Oxford University Press.
43. Nisbett, Richard E., and Timothy D. Wilson. 1977. Telling more than we can know: Verbal reports on mental processes. *Psychological review* 84: 231–259.
44. Murphy, James J., P. Geoffrey Allen, Thomas H. Stevens, and Darryl Weatherhead. 2005. A meta-analysis of hypothetical bias in stated preference valuation. *Environmental and Resource Economics* 30: 313–325. doi:10.1007/s10640-004-3332-z.
45. Burstin, K., E.B. Doughtie, and A. Raphaeli. 1980. Contrastive vignette technique: An indirect methodology designed to address reactive social attitude measurement. *Journal of Applied Social Psychology* 10: 147–165.
46. Nichols, Austin L., and Jon K. Maner. 2008. The good-subject effect: Investigating participant demand characteristics. *The Journal of general psychology* 135: 151–165. doi:10.3200/GENP.135.2.151-166.
47. Finch, J. 1987. The vignette technique in survey research. *Sociology* 21: 105–114. Sage Publications.
48. Knobe, Joshua. 2003. Intentional action and side effects in ordinary language. *Analysis* 63: 190–194.
49. Nichols, Shaun. 2011. Experimental philosophy and the problem of free will. *Science* 331: 1401–1403. doi:10.1126/science.1192931.
50. Krosnick, J.A. 1999. Survey research. *Annual Review of Psychology* 50: 537–567. doi:10.1146/annurev.psych.50.1.537.
51. Eriksson, Kimmo, and Brent Simpson. 2010. Emotional reactions to losing explain gender differences in entering a risky lottery. *Judgment and Decision Making* 5: 159–163.
52. Rand, David G. 2012. The promise of Mechanical Turk: How online labor markets can help theorists run behavioral experiments. *Journal of theoretical biology* 299: 172–179. doi:10.1016/j.jtbi.2011.03.004.
53. Paolacci, Gabriele, Jesse Chandler, and Panagiotis Ipeirotis. 2010. Running experiments on Amazon Mechanical Turk. *Judgment and Decision Making* 5: 411–419.
54. Horton, John J., David G. Rand, and Richard J. Zeckhauser. 2011. The online laboratory: Conducting experiments in a real labor market. *Experimental Economics* 14: 399–425. doi:10.1007/s10683-011-9273-9.
55. Berinsky, Adam J., Gregory A. Huber, and Gabriel S. Lenz. 2012. Evaluating online labor markets for experimental research: Amazon.com’s mechanical turk. *Political Analysis* 20: 351–368.
56. Buhrmester, Michael, Tracy Kwang, and Samuel D. Gosling. 2011. Amazon’s Mechanical Turk: A new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science* 6: 3–5.
57. Henrich, Joseph, Steven J. Heine, and Ara Norenzayan. 2010. The weirdest people in the world? *The Behavioral and brain sciences* 33: 61–135. doi:10.1017/S0140525X0999152X.
58. Cohen, Jacob. 1988. *Statistical power analysis for the behavioral sciences*. Lawrence: Erlbaum.
59. Martel, Laurent, and France-Pascale Menard. 2012. *The Canadian population in 2011: age and sex*. 98-311-X2011001. www.12.statcan.gc.ca. Minister of Industry, Statistics Canada.
60. Howden, L.M., and J.A. Meyer. 2011. Age and sex composition: 2010. Washington: US Census Bureau.
61. Harris, John. 2007. *Enhancing evolution: The ethical case for making better people*. Princeton: Princeton University Press.
62. Fukuyama, Francis. 2002. *Our posthuman future*. New York: Farrar, Straus and Giroux.
63. Reiner, P.B. 2010. Distinguishing between restoration and enhancement in neuropharmacology. *Virtual Mentor* 12: 885.
64. Parens, Erik. 1998. Is better always good?: The enhancement project. *Hastings Center Report* 28: s1–s17.
65. Daniels, Norman. 2000. Normal functioning and the treatment-enhancement distinction. *Camb Quarterly of Healthcare Ethics* 9: 309–322.
66. Nitsche, Michael A., and Walter Paulus. 2011. Transcranial direct current stimulation—update 2011. *Restorative neurology and neuroscience* 29: 463–492. doi:10.3233/RNN-2011-0618.
67. Kahneman, Daniel, and Amos Tversky. 1979. Prospect theory: An analysis of decision under risk. *Econometrica* XLVII: 263–291.
68. Vedder, A., and L. Klaming. 2010. Human enhancement for the common good—Using neurotechnologies to improve eyewitness memory. *AJOB Neuroscience* 1. Taylor & Francis: 22–33.
69. Kahneman, Daniel. 2011. *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.
70. Ariely, Dan. 2008. *Predictably irrational: The hidden forces that shape our decisions*. New York: HarperCollins.
71. Fernandes, Maria F., and Donna M. Randall. 1992. The nature of social desirability response effects in ethics research. *Business Ethics Quarterly* 2: 183–205. doi:10.2307/3857570.
72. King, Maryon F., and Gordon C. Bruner. 2000. Social desirability bias: A neglected aspect of validity testing. *Psychology & Marketing* 17: 79–103.
73. Fisher, Robert J. 1993. Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research* 20: 303–315.

74. Parens, Erik. 1998. *Enhancing human traits*. Washington: Georgetown University Press.
75. Chatterjee, A. 2004. Cosmetic neurology. *Neurology* 63: 968–974.
76. Fehr, Ernst, and Colin F. Camerer. 2007. Social neuroeconomics: The neural circuitry of social preferences. *Trends in Cognitive Sciences* 11: 419–427. doi:[10.1016/j.tics.2007.09.002](https://doi.org/10.1016/j.tics.2007.09.002).
77. Arrow, Kenneth Joseph, Samuel Bowles, and Steven N Durlauf. 2000. *Meritocracy and economic inequality*. Princeton: Princeton University Press.
78. Almås, Ingvild, Alexander W. Cappelen, Erik Ø. Sørensen, and Bertil Tungodden. 2010. Fairness and the development of inequality acceptance. *Science* 328: 1176–1178. doi:[10.1126/science.1187300](https://doi.org/10.1126/science.1187300).
79. Cappelen, A.W., E.Ø. Sørensen, and B. Tungodden. 2010. Responsibility for what? Fairness and individual responsibility. *European Economic Review* 54: 429–441.
80. Schermer, Maartje. 2008. Enhancements, easy shortcuts, and the richness of human activities. *Bioethics* 22: 355–363. doi:[10.1111/j.1467-8519.2008.00657.x](https://doi.org/10.1111/j.1467-8519.2008.00657.x).
81. Parens, Erik. 2005. Authenticity and ambivalence. *Hastings Center Report*: 35:34–41.
82. Sandberg, Anders, and Nick Bostrom. 2006. *Cognitive enhancement: a review of technology*. EU ENHANCE Project. <http://www.enhanceproject.org>
83. Persson, Ingmar, and Julian Savulescu. 2012. *Unfit for the future*. Oxford: Oxford University Press.
84. Elliott, Carl. 2004. *Better than well: American medicine meets the American dream*. New York: W. W. Norton.
85. Stiglitz, Joseph E. 2013. *The price of inequality: How today's divided society endangers our future*. New York: W. W. Norton & Company.
86. McNamee, Stephen, and Robert K Miller. 2009. *The meritocracy myth*. Lanham: Rowman & Littlefield.
87. Norton, M.I., and D. Ariely. 2011. Building a better America—one wealth quintile at a time. *Perspectives on Psychological Science* 6: 9–12. doi:[10.1177/1745691610393524](https://doi.org/10.1177/1745691610393524).
88. Harris, John. 2005. Enhancements are a moral obligation. *WellcomeScience*: 16–17.
89. Baumard, Nicolas, Jean-Baptiste Andre, and Dan Sperber. 2013. A mutualistic approach to morality: The evolution of fairness by partner choice. *Behavioral and Brain Science* 36: 59–78.
90. Kohlberg, Lawrence. 1969. Stage and sequence: The cognitive-developmental approach to socialization. In *Handbook of socialization theory and research*. ed. D.A. Goslin. Chicago: Rand-McNally.
91. Turiel, Elliot, 1983. *The development of social knowledge: Morality and convention*. Cambridge: Cambridge University Press.
92. Haidt, J. 2001. The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review* 108: 814–834.
93. Greene, J.D., R.B. Sommerville, L.E. Nystrom, J.M. Darley, and J.D. Cohen. 2001. An fMRI investigation of emotional engagement in moral judgment. *Science* 293: 2105–2108. doi:[10.1126/science.1062872](https://doi.org/10.1126/science.1062872).
94. Greene, Joshua D., Leigh E. Nystrom, Andrew D. Engell, John M. Darley, and Jonathan D. Cohen. 2004. The neural bases of cognitive conflict and control in moral judgment. *Neuron* 44: 389–400. doi:[10.1016/j.neuron.2004.09.027](https://doi.org/10.1016/j.neuron.2004.09.027).
95. Paxton, Joseph M., Leo Ungar, and Joshua D. Greene. 2012. Reflection and reasoning in moral judgment. *Cognitive Science* 36: 163–177.
96. Jacobson, Daniel. 2013. Moral dumbfounding and moral stupefaction. In *Oxford Studies in Normative Ethics*, ed. M. Timmons, 2: 289–316. Oxford: Oxford University Press.
97. Haidt, Jonathan. 2013. *The righteous mind*. New York: Vintage Books.
98. Haidt, Jonathan, and Fredrik Bjorklund. 2008. Social intuitionists answer six questions about morality. In *Moral Psychology*, ed. W. Sinnott-Armstrong, 181–218. Cambridge: Bradford Books.
99. Haidt, Jonathan, Fredrik Bjorklund, and Scott Murphy. 2000. Moral dumbfounding: When intuition finds no reason. *Unpublished manuscript, University of Virginia*.
100. Bostrom, Nick, and Toby Ord. 2006. The reversal test: Eliminating status quo bias in applied ethics. *Ethics* 116: 656–679.
101. Nadler, Roland C., and Peter B. Reiner. 2010. A call for data to inform discussion on cognitive enhancement. *BioSocieties* 5: 481–482. doi:[10.1057/biosoc.2010.30](https://doi.org/10.1057/biosoc.2010.30).
102. Nadler, R., and P.B. Reiner. 2011. Prototypes or pragmatics? The open question of public attitudes toward enhancement. *AJOB Neuroscience* 2: 49–50. Taylor & Francis.
103. Guston, David H. 2004. Forget politicizing science. Let's democratize science! *Issues in Science and Technology* 28: 25–28.
104. Gupta, N., A.R.H. Fischer, and L.J. Frewer. 2012. Sociopsychological determinants of public acceptance of technologies: A review. *Public Understanding of Science* 21: 782–795. doi:[10.1177/0963662510392485](https://doi.org/10.1177/0963662510392485).
105. Erikson, Robert S, Gerald C Wright, and John P McIver. 1993. *Statehouse democracy: Public opinion and policy in the American states*. Cambridge: Cambridge University Press.
106. Levine, Michael E., and Jennifer L. Forrence. 1990. Regulatory capture, public interest, and the public agenda: Toward a synthesis. *Journal of Law, Economics, & Organization* 6: 167–198. JSTOR.
107. Fischer, F. 2003. *Reframing public policy: Discursive politics and deliberative practices*. Oxford: Oxford University Press.
108. Burstein, Paul. 2003. The impact of public opinion on public policy: A review and an agenda. *Political Research Quarterly* 56: 29–40.
109. Kraft, Michael E, and Scott R Furlong. 2012. *Public policy: Politics, analysis, and alternatives, 4th Edition*. Los Angeles: CQ Press.
110. Kleiman, Mark A R, Jonathan P Caulkins, and Angela Hawken. 2011. *Drugs and drug policy*. Oxford: Oxford University Press.
111. DeSantis, Alan D., Elizabeth M. Webb, and Seth M. Noar. 2008. Illicit use of prescription ADHD medications on a college campus: A multimethodological approach. *Journal of American college health* 57: 315–324. doi:[10.3200/JACH.57.3.315-324](https://doi.org/10.3200/JACH.57.3.315-324).
112. Outram, Simon M. 2010. The use of methylphenidate among students: The future of enhancement? *Journal of Medical Ethics* 36: 198–202.
113. Appel, J.M. 2008. When the boss turns pusher: A proposal for employee protections in the age of cosmetic neurology. *Journal of Medical Ethics* 34: 616–618. doi:[10.1136/jme.2007.022723](https://doi.org/10.1136/jme.2007.022723).