SMART POLICY: COGNITIVE ENHANCEMENT AND THE PUBLIC INTEREST

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Background

Definition

Cognitive enhancement is the amplification or extension of core capacities of the mind through improvement or augmentation of internal or external information processing systems. Cognition refers to the processes an organism uses to organize information. These include acquiring (perception), selecting (attention), representing (understanding) and retaining (memory) information, and using this information to guide behaviour (reasoning and coordination of motor outputs). Interventions to improve cognitive function may be directed at any of these core faculties.

Biomedical enhancement as part of a wider spectrum of enhancement methods

Such interventions may take a variety of forms, many of them age-old and mundane. The prime example is education, where the goal is often not only to impart specific skills or information but also to improve general mental faculties such as concentration, memory, and critical thinking. Other forms of mental training, such as yoga, martial arts, meditation, and creativity courses are also in common use. Caffeine is widely used to improve alertness. Herbal extracts reputed to improve memory are popular, with sales of Ginkgo biloba alone on the order of several hundred million dollars per year in the U.S.[1] In an ordinary

[1] (van Beek 2002)

supermarket or health food store we can find a veritable cornucopia of energy drinks and similar preparations, vying for consumers hoping to turbo-charge their brains.

As cognitive neuroscience has advanced, the list of prospective biomedical enhancements has expanded.[2] Yet, to date, the most dramatic advances in our effective cognitive performance have been achieved through non-biomedical means. Progress in computing and information technology has vastly increased our ability to collect, store, analyze, and communicate information. External hardware and software supports now routinely give humans beings effective cognitive abilities that in many respects far outstrip those of our biological brains. Another important area of progress has been in 'collective cognition' – cognition distributed across many minds. Collective cognition has been enhanced through the development and use of more efficient tools and methods for intellectual collaboration. The World Wide Web and e-mail are among the most powerful kinds of cognitive enhancement developed to date. Non-technological approaches to enhancing collective cognition have also made important advances: it is possible to view institutions, such as academic peer-reviewed journals, and social conventions, such as limitations on the use of *ad hominem* arguments in discussions, as part of the cognitive enhancement spectrum.

It is useful to bear in mind this wider perspective on the various forms that cognitive enhancement can take. Such a perspective helps us see just how important advances in cognitive and epistemic functioning are to individuals and to modern societies. It also helps us avoid a myopic fixation on biological paths to enhancement to the exclusion of other ways of achieving similar goals, which in many cases may be more practicable. Nevertheless, biomedical forms of cognitive enhancement are worthy of serious consideration, not only because of their novelty but also because they could eventually offer enormous leverage. Consider, for example, the cost-benefit ratio of a cheap, safe, cognition-enhancing pill compared to that of years of extra education: in terms of improving cognition, both could achieve similar results, yet the biomedical route would do so using a tiny fraction of the time and resources demanded by the educational route.

In this paper, we concentrate mainly on biomedical cognitive enhancements, but many of our remarks apply equally to enhancements that work on non-cognitive capacities, and to non-biomedical means of enhancement.

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[2] For a recent review of various cognitive enhancement methods, see (Bostrom & Sandberg 2007), (Farah, Illes et al. 2004).

Assessment

Protecting and promoting cognition as accepted goals in current practice

There are many laws and regulations instituted with the purpose of protecting and improving cognitive function. Regulation of lead in paints and in tap water; requirements of boxing, bicycle, and motorcycle helmets; bans on alcohol for minors; mandatory education; folic acid fortification of cereals; legal sanctions against mothers taking drugs during pregnancy: these all serve to safeguard or promote cognition. To some extent, these efforts may be motivated by a concern to promote general health; yet greater efforts appear to be made when cognitive function is at risk. Such regulations seem implicitly to recognise the value of cognition. By contrast, we are unaware of any public policy intended to limit or reduce cognitive capacity. One may also observe that mandated information duties, such as labelling of food products, were introduced to give consumers access to more accurate information in order to enable them to make better choices. Given that sound decision-making requires not only reliable information, but also the cognitive ability to retain, evaluate, and use this information, one would expect that enhancements of cognition will also promote rational consumer choice.

Feasibility of biomedical enhancement of cognition: narrow vs. wide enhancement targets

At present, biomedical enhancement techniques produce at best modest gains in cognitive performance. Reported improvements of 10-20% in some test task are typical. It remains unclear to what extent such improvements in a laboratory setting would translate into performance gains on real-world tasks. The sustainability of any short-term gains is also often unclear. For example, although stimulants can temporarily reduce the need for sleep and improve performance in sleep-deprived subjects, it is unclear whether the long-term use of such drugs would improve work capacity.

More dramatic results can be achieved through training and human-machine collaboration. Mental techniques (e.g., mnemonic tricks) can achieve upwards of 1,000% improvement in narrow domains such as specific memorization tasks[3]. However, while biomedical enhancements do not produce dramatic improvements on specific tasks, their effects are typically broad. A drug might, for instance, enhance performance on all tasks that rely heavily on working memory, or on long-term memory. External tools and cognitive techniques such as mnemonics, by contrast, are usually task-specific, producing potentially huge improvements in relatively narrow abilities. To evaluate the value of some enhancement, one must consider not only the degree to which some capacity is enhanced,

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[3] (Ericsson, Chase, and Faloon 1980)

but also how general and useful this capacity is. The broader the target capacity, the greater the potential positive effects of even a small degree of enhancement.

Correlates and consequences of higher cognitive ability

General cognitive capacity of individuals—imperfectly measured by IQ scores—is positively correlated with a number of desirable outcomes. It reduces the risk of a wide array of social and economic misfortunes[4], such as bad health[5], accidents[6], and even being the victim of homicide[7], while reducing overall mortality[8] and improving educational outcomes. In prisoner's-dilemma type experiments people with higher cognitive abilities cooperate more often and appear to have a stronger future orientation[9], something that appears to promote economic success[10]. While many non-cognitive factors also play large roles in determining professional and life success, cognitive capacity is part of an important feedback loop of human capital acquisition.

At a societal level, the sum of many individual enhancements may have an even more profound effect. Economic models of the loss caused by small intelligence decrements due to lead in drinking water predict significant effects of even a few points change[11]. Correspondingly significant *benefits* can be expected if a similarly small amount of intelligence were gained instead of lost.[12] It may therefore be worth seriously considering the possibility that improving cognition could have benefits not only for individuals, but also cultural and economic benefits for society.

It is important to remain aware when weighing evidence about the efficacy of pharmacological enhancers that such drugs are typically tested within a laboratory setting for particular tasks. While this enables more exact measurement and elimination of confounders, its relevance to real life situations is debatable. One could imagine, for example, that some drug increases performance on one kind of task, while subtly decreasing performance on various other tasks that were not included in the test battery. Alternatively, some drug might give a short-term benefit but its efficacy might degrade with use over longer periods than those used in testing (some stimulant drugs, for example, might fit this pattern). Or a drug might improve some particular capacity yet fail to produce meaningful

[4] (Gottfredson 1997; Gottfredson 2004)
[5] (Whalley and Deary 2001; Pavlik 2003; Batty 2009a)
[6] (Batty 2009b)
[7] (Batty 2008)
[8] (Batty 2007)
[9] (Jones, 2008)
[10] (Burks, 2009)
[11] (Salkever 1995) (Muir and Zegarac 2001)
[12] (Bostrom and Ord 2006)

improvements in key outcomes variables such as academic performance, economic productivity, or life satisfaction. Furthermore, people's values and lifestyles might lead them to use enhancement technologies in non-prescribed ways, with unexpected and possibly undesirable results. There is scant data at the current time on such "ecological effects" of cognitive enhancers.

Ethical concerns

The prospect of enhancement often evokes ethical concerns. Generally speaking, only certain types of enhancement give rise to discussion of such concerns. 'Conventional' means of cognitive enhancement such as education, mental techniques, neurological health initiatives, external information technology, and epistemic institutions are quite uncontroversial. 'Unconventional' means such as drugs, implants, direct brain-computer interfaces, and genetic engineering are more likely to evoke moral concerns. The boundary between these two categories, however, may increasingly blur. For instance, neurological 'health' objectives such as maintaining full cognitive performance into old age, or remedying specific cognitive deficits such as a concentration and memory problems, are likely to become increasingly hard to distinguish from enhancement objectives as the range of available biomedical interventions expands.

We suspect that the controversy surrounding unconventional means of cognitive enhancement (with the possible exception of germ-line genetic therapy) is largely due to the fact that they are currently novel and experimental rather than to any problem inherent in the technologies themselves. As we learn, through research and practical experience, about the strengths and weaknesses of these unconventional methods for improving cognitive performance, our acceptance of them is likely to increase. This is what has happened with many once-controversial technologies such as oral contraceptives, IVF, and even the telescope. The debate about cognitive enhancement might then become absorbed into the ordinary discussions about the merits and demerits of various kinds of tools, technologies, medicines, and practices.

Opinions about the value of enhancements are also influenced by the fact that enhancements aim to effect deviations from the status quo—that is, from what we regard as 'normal'. Allowing status quo bias to affect our attitudes towards enhancement could result in our missing out on valuable goods. One of us has outlined a method for reducing the influence on our judgements of status quo bias.[13]

A more specific concern about biomedical cognitive enhancement has recently hit the headlines[14]. Following reports that some students use currently available drugs like

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[13] (Bostrom and Ord 2006)

[14] For example, (Henderson 2008).

Modafinil and Ritalin to improve examination performance, some worry that use of such 'smart drugs' constitutes cheating[15]. The accusation of cheating is figurative: an activity constitutes cheating if it allows participants to gain an advantage by violating a rule, but currently no rules prohibit using smart drugs. Those who claim that use of smart drugs constitutes cheating, then, are best understood as claiming that such drugs enable users to gain an unfair advantage, and that therefore the rules ought to be changed so as to prohibit them. Assessing whether they ought to be banned in educational institutions requires addressing questions about the value of education and our attitudes towards other more familiar methods of improving examination performance, such as working hard or hiring a private tutor.[16] A more nuanced approach to the issue could assess enhancements on a case-by-case basis, taking the context into account, and considering factors such as the health risks of different enhancers, their cost and availability, the feasibility of detecting illicit use, and whether individual rights would be infringed by a prohibition. If a smart drug could be proven sufficiently safe and effective, then instead of being forbidden, its use could be encouraged for the same reasons that students are now encouraged to eat and sleep well, to revise, and to take notes in preparation for exams.

If enhancement could really deliver great benefits, should we consider the possibility that there is there a right to enhance? While access to medicine is commonly regarded as a human right constrained by cost concerns, it is less clear whether access to all enhancements should be regarded as a positive right. The case for at least a negative right to cognitive enhancement based on cognitive liberty, privacy interests, and the interest of persons in protecting and developing their own minds and capacity for autonomy, seems very strong[17]. Proponents of a positive right to (publicly subsidized) enhancements could argue their case on grounds of fairness or equality, or on grounds of a public interest in the promotion of the capacities required for autonomous agency. The societal benefits of effective cognitive enhancement may turn out to be so large and unequivocal that it would be economically efficient to subsidize enhancement for the poor, just as the state now subsidizes education.

[15] For example, (Rose 2005), (Gazzaniga 2005), (Schermer 2008), (Sahakian and Morein-Zamir 2007), (Warren et al. 2009)

[16] One of us has argued elsewhere that, following such consideration, the use of smart drugs ought not to be viewed as akin to cheating, since there is no significant general difference between using smart drugs and, say, hiring a private tutor (Roache 2008).

[17] A case for a negative right to enhancement is made by (Sandberg 2003; Boire 2001)

Policy issues

Drug approval criteria

One major obstacle to the development of safe and effective biomedical enhancers is the present system for licensing drugs and medical treatments. This system was created to deal with medicine that aims to prevent, detect, cure, or mitigate diseases. In this framework, there is no room for enhancing medicine. Drug companies seeking regulatory approval for a pharmaceutical useful solely for improving functioning in the healthy population would face an uphill struggle without major changes to the current licensing framework.

To date, every licensed pharmaceutical on the market that offers some potential cognitive enhancement effect was developed to treat some specific disease condition, such as attention-deficit hyperactivity disorder (ADHD), narcolepsy, or Alzheimer's disease. The enhancing effect of these drugs in healthy subjects is a serendipitous unintended benefit. It seems likely that progress in developing biomedical enhancements would be accelerated if pharmaceutical corporations could focus directly on developing nootropics for use in non-diseased populations rather than having to work indirectly by demonstrating that the drugs are efficacious in treating some recognized disease.

One of the perverse effects of the failure of the current medical framework to embrace the potential of enhancement medicine is the trend towards the 'pathologization' of an increasing range of conditions previous regarded as part of the normal human spectrum. If, for example, a significant fraction of the population could obtain certain benefits from drugs that improve concentration, it is currently necessary to categorize these people as having some disease—in this case ADHD—in order to allow them access to the drugs in question via the usual channels, such as prescription by a GP. This disease-focused medical model is increasingly inadequate in an era in which many people will be using medical treatments for purposes of modification or enhancement.

Research funding

One consequence of the disease framework for drug regulation is to discourage investment in development of cognitive enhancers. Pharmaceutical firms can be expected to refrain from investing in development and testing of drugs for which they expect regulatory approval to be unobtainable.

Academic research is also hampered by the disease framework, since researchers find it difficult—even impossible—to secure funding to study potential cognitive enhancers except in contexts where the study can be linked to some recognized pathology.[18] As a result, public funding for research into biomedical cognitive enhancement does not yet

[18] Danielle Turner and Barbara J Sahakian, personal communication.

reflect the potentially vast personal and social benefits that could be realized through the development of safe and effective enhancers. A case could be made that even on purely economic grounds, the field deserves large-scale funding, since the limited available evidence suggests large potential economic gains from increased cognitive abilities.

Regulation of access to enhancers

The medicine-as-treatment-for-disease paradigm creates problems not only for pharmaceutical companies and academic researchers, but also for individual users whose access to enhancers is often dependent on being able to find an open-minded physician who will prescribe the drug. This creates inequities in access. People with high social capital and good information get access while others are excluded.

Any novel technology poses risks, and biomedical cognitive enhancement is no exception. Assessing the seriousness of the potential risks, and deciding how to respond to them, requires taking into account not only what harms might accrue from irresponsible use of such technology, but also the potentially great benefits offered by enhancement. Some opponents of enhancement ignore its potential benefits and focus only on the risks, leading to an overly pessimistic attitude towards enhancement[19]: a result, perhaps, of the sort of status quo bias mentioned in the previous section. A more constructive approach would focus not only on anticipating potential harms and benefits, but also on identifying potential supporting policies and practices that can alter the balance for the better.

As cognitive enhancement technology grows more sophisticated, so must legislation to promote cognitive function. In part, it is likely that this will be due to the practical challenge of deciding which cognitive capacities to enhance, which may at least sometimes entail a trade-off between different cognitive abilities. For example, staying awake by using stimulants prevents the memory consolidation that occurs during sleep, meaning that enhanced wakefulness may not be possible without paying a price in terms of a reduction in memory functioning. It may not always be possible to predict in advance where such trade-offs are likely to occur: whilst our biology and evolutionary history gives us some important clues[20], new enhancement drugs may give rise to unexpected effects, some of which might be subtle and take a long time to manifest.

This raises the point that a 'one size fits all' approach is unlikely to be suitable for enhancement. While the value of being cured of some disease is often similar across individuals who have the disease, the benefit to an individual of some particular enhancement will often depend sensitively on his or her personal values, preferences, and

[19] See, for example, (Kass, 2003), (Sandel, 2004), (Fukuyama, 2002).

[20] (Bostrom and Sandberg 2009)

idiosyncratic context. This suggests that in many cases individuals will be best placed to decide for themselves whether and how to enhance.

At the same time, many will feel the need for a limited degree of paternalism that would protect individuals from the worst risks. How, then, can a policy approach best be determined?

One option would be to establish some baseline level of acceptable risk in approved interventions. This could be done through comparison with other risks that society allows individuals to take (merely for fun or on any personal whim or preference), such as risks from smoking, mountain climbing, or horseback riding. Enhancements that could be shown to be no more risky than these activities would be allowed, with appropriate information and warning labels when necessary.

Another possibility would be 'enhancement licences'. People willing to undergo potentially risky but rewarding enhancements could be required to demonstrate sufficient understanding of the risks and the ability to handle them responsibly. This would ensure informed consent and enable better monitoring. However, it would discriminate against poorly educated individuals. In particular, those of low cognitive capacity, who may have the most to gain from some enhancements, could find it hard to gain access if licence requirements were demanding.

The increasing popularity of cosmetic surgery[21] highlights an important area of risk that may also arise in the case of cognitive enhancement. As more cosmetic procedures of different types become available, there arises the problem that some new procedures may not be covered by extant legislation. As a result, the public may believe that cosmetic procedures are strictly regulated even though some types of procedure 'slip through the net' and can be offered by practitioners who have undergone only minimal training[22]. The result is that the public may feel over-confident about undergoing inadequately regulated procedures. Something similar could happen with cognitive enhancement. Regulation of such drugs would need to be continuously reviewed in order to ensure that the public is protected from the worst harms of irresponsible enhancement use.

Low-hanging fruits

Special attention should be given to areas in which relatively easy, inexpensive, and low-tech approaches are likely to be able to achieve comparatively big results.

One such approach might involve ensuring that infant formula contains the nutrients required for optimal neurological development functioning. Evidence on prenatal and

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[21] In 2007, 32,453 cosmetic procedures were carried out in the UK, compared to 28,921 in 2006, 22,041 in 2005, and 16,367 in 2004 (British Association of Aesthetic Plastic Surgeons 2008).

[22] (British Association of Cosmetic Doctors 2009)

perinatal nutrition suggests that the composition of infant formulas and maternal nutrition can have a significant life-long impact on cognition. Recent studies have indicated that children's IQ can be improved by increasing maternal docosahexaenoic acid (DHA) intake during pregnancy[23], by supplementing infant formula with DHA[24], and by increasing the period for which the infant is breastfed[25]. Good infant nutrition can increase a child's IQ by as much as 5.2 points in cases where low birth weight infants are fed human milk[26]. Because of the low cost and extremely large potential impact of enriching infant formula with the nutrients needed to ensure optimum cognitive functioning if applied at a population level, it should be a priority to conduct more research to establish the optimal composition of infant formula in order to maximize cognitive ability in bottle-fed children. Regulation could then be put in place to ensure that commercially available formula contains these nutrients. Public health information campaigns could further promote the use of enriched formula or breast-feeding practices. This would be a simple extension of current regulatory practice, but potentially a highly effective one.

Another easy and cheap approach to increasing cognitive functioning is to treat the two billion people worldwide suffering from iodine deficiency, the world's most common cause of preventable mental impairment[27]. Those worst affected by iodine deficiency are found in inland areas of sub-Saharan Africa, South Asia, and Central and Eastern Europe/Commonwealth of Independent States[28]. Iodine deficiency adversely affects health in a number of ways, and its specific effect on cognition is severe: iodine deficient populations average between 12.5 and 13.5 IQ points less than normal populations[29]. The deficiency can be easily treated by supplementing food with iodized salt; an intervention costing about $0.05 per person per year[30]. The cost of such an intervention is dwarfed by the cost to the developing world of iodine deficiency: it has been estimated that iodine supplementation would avert specifically cognitive losses with a benefit:cost ratio of 30:1[31], and losses to general health with a benefit:cost ratio of 70:1[32]. When we factor in the less quantifiable benefits to sufferers and their communities of improved cognitive function—in terms, for example, of well-being, choices, quality of life, and personal relationships—the

[23] (Cohen 2005)
[24] (Birch 2007), although see (Scott 1998) for a competing view.
[25] (Horwood and Fergusson 1998)
[26] (Anderson 1999)
[27] (Zimmermann 2008)
[28] (Horton 2008)
[29] (Qian 2005)
[30] (Horton 2008)
[31] (Horton 2008)
[32] (Horton 2006)

ratios increase further still. It is morally and prudentially scandalous that this problem has not already been solved.

Given the scale and adverse effects of iodine deficiency compared with the relative ease of treating it, this final example powerfully illustrates that cognitive enhancement policy need not centre on preparing the ground for sophisticated, yet-to-be-realized technologies. 'Smart policy' should, rather, take as its starting point the recognition that effective cognition is not only subjectively valuable to individuals, but also delivers significant social, cultural, financial, and scientific benefits. Maximizing these benefits need not be difficult, risky, controversial, or expensive.

Recommendations

- Conceptualize biomedical cognitive enhancers as part of a wider spectrum of ways of enhancing the cognitive performance of groups and individuals.
- Modify the disease-focused regulatory framework for drug approval into a well-being-focused framework in order to facilitate the development and use of pharmaceutical cognitive enhancement of healthy adult individuals.
- Assess risks by balancing against benefits rather than against the status quo, and by allowing individuals to determine risk acceptability where appropriate.
- Provide public funding for academic research into the safety and efficacy of cognitive enhancers, for the development of improved enhancers, and for epidemiological studies of the broader effects of long-term use.
- Increase public funding for research aimed at determining optimal nutrition for pregnant women and newborns to promote brain development.
- Address the problem of iodine deficiency as a global priority.
- Bear in mind that enhancement regulation may need to be continuously reviewed in order to keep in step with progress.[33]

[33] We are grateful to Anders Sandberg for research collaboration.

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