Ethics department

# Boosting your brainpower: ethical aspects of cognitive enhancements

## A discussion paper from the British Medical Association

How might we try to enhance cognition?

What are the ethical and social implications of cognitive enhancements?

How should society respond?

Key questions for debate and consideration

November 2007

BMA

# Boosting your brainpower: ethical aspects of cognitive enhancements

## A discussion paper from the British Medical Association

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## Expert Group on Cognitive Enhancements

This document is based upon discussions held during a roundtable meeting of experts held on 24 November 2006 hosted jointly by the British Medical Association and the Royal Institution of Great Britain. We wish to thank the following people for their attendance at, and contribution to, this meeting and for their helpful comments on an earlier draft of this paper. Although these contributions helped to inform the discussion paper, it should not be assumed that this document represents a consensus among the views of those who were consulted.

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## Medical Ethics Committee

A publication from the BMA's Medical Ethics Committee (MEC) whose membership for 2007/08 was:

## EXECUTIVE SUMMARY


- People have long been interested in improving their brainpower. Developments in medicine and pharmacy could provide new ways of doing that but because they raise ethical issues that have not been widely discussed, there is a need for public debate about them. In Part One, this paper sets out some definitions and a framework for debate.

- Drugs and medical interventions designed as therapy for people with diagnosed problems are likely to be sought in future by healthy people to "improve" on nature. It is important to distinguish, however, between what is possible now or will be in the near future and more abstract speculation about longer-term developments. In Part Two, the document examines the evidence (or lack of it) for different methods of enhancement, including nutritional supplements, pharmaceuticals and surgery.

- People may not only want to choose enhancement for themselves but also for their children. The possibilities and limitations of genetic manipulation and selection as a means of enhancing future people are also covered in Part Two.

- Individuals have always been able to try and improve their own or their children's intellectual abilities through study and effort. The possibility of shortcutting that process and lessening the effort required by using nutrition, drugs or medical techniques is more controversial. Part Three considers why this might be.

- It looks at the speculation about how the new technologies might bring about either positive or negative social and cultural changes, affecting not only individuals but the fabric of society. Arguments that have been put forward by those for and against such a change are briefly summarised.

- One of the main arguments concerns interconnectedness. For the purposes of discussion, the paper looks at cognitive functioning as if it could be isolated from other parts of a person's life. In reality the potential risks or benefits of cognitive enhancement for other aspects of individuals' personality, such as emotional stability and creativity, cannot be isolated. People are also interconnected in a social sense, so that choices made by some are likely to impact on others and possibly on society at large. This is highlighted throughout the paper and discussed in detail in Part Three where some suggestions are considered about how a balance might be attained between personal liberty and responsibility to the community.

- Why we may have quite different moral views about different methods, even though they all have the same goal, is also discussed in Part Three.

- Almost anything we try may have some unforeseen side-effects or carry some risks. In order to decide whether change should be regulated, the scope and limits of what individuals should be able to choose for themselves or for other people also need to be discussed. Part Four sets out the arguments for and against limiting choice and considers how regulation, if needed, might be implemented.

- The main questions arising from the paper are summarised in Part Five. The BMA does not have policy or recommendations to put forward on these issues but would welcome informed public debate about how, as a society, we should respond to these developments.

## INTRODUCTION

*Have you ever used coffee, or other products containing caffeine, to try to improve your concentration or to keep you awake while studying or during particularly busy periods of work? If there was a drug, or a medical procedure, that was proven to increase your concentration, improve your memory, aid learning or help you make better decisions, would you want to use it? Should you be able to?*

Attempts to improve aspects of cognitive ability and functioning are nothing new, but as evidence emerges of the success of some of these methods, questions are being raised about the extent to which their use should be permitted, tolerated or even encouraged. There is evidence that some pharmaceutical products, or medical procedures developed to treat recognised medical conditions may also enhance intellectual performance in healthy individuals. There is also evidence that some of these methods are already being used surreptitiously by US students as study aids. Not surprisingly then, there is a growing expectation that the use of these so-called "cognitive enhancers" in the UK is both imminent and inevitable.

Despite a large and growing academic literature about the development and use of cognitive enhancements, there has been very little public debate about the way society should respond to these developments and what, if any, public policy response is needed. This paper aims to encourage such a debate, by looking at what is possible now, what may be possible in the next 20-30 years and highlighting some of the key ethical, social and legal issues raised. It is not necessary to have a detailed understanding of the brain, and the way it functions, in order to discuss the issues raised in this paper but for those who wish to have a better understanding of some of the terms and concepts used, a basic guide to the brain is provided as an Appendix.

### Aim of this paper

The key aim of this paper is to facilitate informed debate amongst doctors, scientists, policy-makers, and members of the public about the future development and use of cognitive enhancements. It does this by providing those who wish to engage in the debate with the facts, information and some of the arguments they need in order to do so. The paper gives arguments and counter-arguments, allowing readers to judge for themselves the weight to attribute to them and to decide which they personally find more persuasive. It does not, therefore, provide answers but questions. It does not signal the end, but rather the beginning, of a debate about how, as a society, we should consider and respond to the opportunities and challenges presented by cognitive enhancements.

### Why is this issue relevant to the BMA?

Many people are familiar with the BMA as the doctor's trade union but, in fact, it has a much wider remit. It is also the professional association for doctors, charged with promoting good practice, providing ethical advice and guidance and actively engaging with the development of public policy in areas related to health. The BMA sees an important part of its role as identifying future health-related issues that impact both on individuals and on society and facilitating informed debate within the medical profession and beyond.

Given the nature of some of the methods of enhancement discussed in this paper, it is also possible that doctors will be directly involved in providing or monitoring these drugs or procedures. Before doctors begin to receive such requests, it is important to consider now what is and is not reasonable for doctors to do and the extent to which their remit could, or should, be extended beyond what might be termed therapeutic interventions to include those that are sought for purely social reasons. Doctors may also be expected to "pick up the pieces" if things go wrong, if people seek enhancements through illicit routes, without proper controls and experience serious side-effects. Or doctors themselves might want to share in the benefits of enhancement, to aid concentration during long shifts or periods on-call, for example.

### Why is this issue relevant to society?

These are not just issues for doctors, however, they are issues for society. We all need to decide whether we want to live in a society in which the use of cognitive enhancements are routine. There are both advantages and disadvantages to such a future and these need to be carefully considered to decide how best to proceed.

Debate about such issues can sometimes appear abstract and to have no relevance to the everyday lives of ordinary members of the public. It is true that some of the academic literature looks much further to the future than this paper, to what some might consider science fiction. Philosophers speculate about the possibility and the implications of people

becoming "post-human" or "trans-human" and our development into a new species that has "super-human" powers. But this should not distract us from the very real and practical issues that are confronting us now, or will confront us in the near future. This paper focuses on attempts to improve cognition within normal species functioning. In other words to help people to achieve their full potential. These are very real issues that have implications for us all.

## Why is this issue ethically important?

Any technology that involves risks and benefits that go beyond the individual raises ethical questions. There are questions about the limits of individual choice, whether there are legitimate reasons to prevent individuals from making their own decisions, the ability of people to consent to unknown and potentially unknowable risks for themselves and for others and the implications for society as a whole of its widespread adoption. Many techniques that involve attempts to modify or improve aspects of ourselves or others are seen as ethically problematic. It is also true, however, that interventions seen as controversial when first introduced often become more accepted or even routine over time. Initially, for example, efforts to enhance the body through cosmetic surgery were seen as controversial but are now commonplace. One reason for initial anxiety was because such surgery affects our bodies which are symbolic of who we are. Our mental faculties are even more intimately linked with who we are. Therefore, particular concerns arise from interference with the brain precisely because it is intrinsically linked with our personality and individuality and because the long-term effects of interfering with this very complex system are unknown. The personal and societal implications of the use of cognitive enhancements need to be carefully assessed and balanced before deciding on an appropriate response.

## The need for a rational debate

Many commentators, including some strong supporters of enhancements, have pointed out that initial suggestions of improving cognitive ability have been "widely rejected" and "met with extreme hostility".[1] It is important to assess, however, whether this opposition is based solely on the familiar "yuk factor" which is not uncommon in relation to new technology. It is instructive to consider society's initial opposition to heart transplantation or in vitro fertilisation (IVF) compared with their widespread use and acceptability now, to recognise that the "yuk" phenomenon is very real. It is also evident from research that individuals do tend to favour what they know over what they do not know – this is sometimes referred to as "status quo bias".[2] Similar attitudes can be reflected in the desire to support a "precautionary approach" which can make people reluctant to try new things.

Of course, we may not object to the aim of the technology but simply to the technology used. So we may not object to reform of the education system in order to improve overall cognitive ability, but we may object to the use of pharmaceutical, surgical or genetic methods of achieving that aim. This is an acceptable position but it cannot simply be based on an instinctive "yuk" reaction; we need to consider and clearly articulate our reasons for that opposition if it is to have any meaningful impact on future policy development. That is not to dismiss entirely our initial reactions since there is a place for such intuitive responses but that place is to act as a brake, to make us stop and consider whether that reaction is based on sound and logical reasons or if it is simply based on prejudice or fear of the unknown.

It is very likely that methods of cognitive enhancement will be developed and used by some people. Now is the time to begin to consider the implications of this and to decide how as a society we should respond.

## PART ONE – SETTING THE SCENE

### What do we mean by "cognition"?

"Cognition" and "intelligence" describe a range of mental abilities. "Cognition" comes from the Latin verb meaning to learn and is defined as the mental act or process by which knowledge is acquired, including by perception, intuition and reasoning. "Intelligence" comes from the Latin meaning ability to "choose between" or be discerning and is one facet of the broader concept of cognition. In our use of the terms, we focus as much as possible on what appear to be the most measurable facets of mental activity, rather than "social" intelligence or emotion. Excluded from this discussion, therefore, are aspects of personality such as mood, empathy, creativity and emotion, which are all aspects less susceptible to accurate measurement than the facets discussed here. Whilst this purely theoretical distinction is made here just for the purpose of discussion, it is important to bear in mind that, in real life, these various aspects of personality cannot be isolated but are interlinked. So that attempting to change or improve one facet of people's mental life might affect other aspects, including their mood or emotion, in a positive or negative way. It cannot be assumed, therefore, that greater cognitive ability would necessarily make people happier or give them a greater sense of well-being.

The concepts of cognition and intelligence discussed in this paper include individuals' analytical ability to understand context and how ideas relate to one another; to see the implications of any idea or proposal, to identify patterns, parallels and analogies in phenomena that appear dissimilar and the ability to distinguish between things that superficially seem the same. Neither term is just about the scale of individuals' understanding, memory and reasoning skills but also about aspects such as the speed at which they grasp new concepts. Our use of the term "cognitive ability" also seeks to capture some other aspects of human intellect, such as learning, memory and attention and executive functions including decision-making, planning, problem-solving and cognitive flexibility. Attempts to enhance "cognitive ability" may be aimed at boosting an individual's abilities in relation to any one or more of these components thereby improving their performance. In some cases, however, an enhancement in one area such as an improvement in the speed at which ideas are grasped is offset by deterioration in another, so that the individual reacts more swiftly than usual but gets the wrong answer.

#### Scientific efforts to improve cognition

Facets of cognition can be damaged and fail to develop, or decline normally with age. Scientific research is increasingly attempting to investigate how changes in molecules, cells, brain circuits and the chemistry within the brain result in changes in cognition. A particular target for researchers is to find potential ways of improving learning and memory. Although research has revealed a lot about the cellular and molecular basis of learning and memory, much remains to be discovered about how new information is stored, consolidated and either retrieved or forgotten over time.[3] The Foresight Project identified the central mechanism underpinning memory as synaptic plasticity which can be briefly defined as changes in the strength and size of synapses that increase or decrease efficiency of transmission of signals within the brain[4] (see Appendix for more information about these processes). Synapses are formed by experience. Roles in learning and memory are attributed to new synapse formation and loss, the proliferation and survival of new neurons and neuronal cell death. It suggests that each of these processes provides possible targets for cognitive enhancement in healthy people.

Susan Greenfield summarises the importance of this process of synaptic transmission saying: "Everything we think and feel can ultimately be boiled down to this sequence of electrical and chemical events."[5]

#### Measuring cognition

In order to assess whether cognition can be improved, there needs to be a way of measuring it but there is debate about whether this can be done reliably. Since the start of the twentieth century, various tests have been used to measure intelligence quotient (IQ) but such efforts have been dogged by controversy and disagreement. This was at least partly due to the social and political context within which IQ tests originated and the political and ideological conclusions that were drawn from the results. While some people think that IQ tests can be useful as a general benchmark of a person's abilities in certain contexts, other experts argue that intelligence is too complex to be measured by such methods because it has so many different facets. Furthermore, tests which seek to measure it have often been culturally biased. Critics also point out that individuals can appear to do well in such tests simply by having considerable experience of how they work or having undergone training in how to complete them, so that the tests cannot necessarily be considered indicative of cognitive abilities. Although we may be unable reliably to measure "intelligence", some facets of it, such as memory, are amenable to testing.

### How is "cognition" used in this paper?

Recognising the difficulty of reaching agreement on both the precise definition and measurement of cognition, and for the sake of clarity, we have listed below the main aspects of cognition that we are interested in for the purpose of this paper. These are:

- learning, memory and information retrieval;
- concentration and attention;
- speed of processing;
- visuo-spatial ability; and
- executive functions including planning and the ability to carry out abstract reasoning.

## What do we mean by "enhancement"?

Having established a broad definition of cognition or cognitive ability, "cognitive enhancement" obviously involves some measurable improvement or increase in one or more aspects of cognitive ability. "Enhancement" is an increase in quality, value or power and can apply equally well to improving something that is deficient as to refining something that looks or works well. In popular usage, however, the term often has the connotation of improving upon nature and giving additional power or quality above that which is essential. Thus enhancement in any sphere is often seen as an extra benefit rather than a necessity. Despite this perception, the term "cognitive enhancement" originally arose from the treatment of disease-associated cognitive impairment. Originally associated with the treatment of serious conditions such as Korsakoff's syndrome[6] (a memory disorder), dementia and schizophrenia, the term later came to include treatments for milder cognitive impairments which do not necessarily impinge on an individual's ability to function.[7] Now the term has been diluted or extended further to include treatments to counteract facets of normal ageing and also interventions with a non-medical goal of improving the abilities of younger people without a specific medical diagnosis.

### Therapy or enhancement?

Although this expansion of medical technology to include social goals is far from new, the use of drugs and other biomedical technologies for these purposes is not uncontroversial and there is a lingering anxiety for many people that medical priorities may be distorted or result in trivialisation of scientific developments. Unfortunately, for those who would like to draw clear boundaries, however, whether an intervention should be classified as therapy or enhancement is a judgement always made in the eye of the beholder. Where an individual suffers from a clearly defined and diagnosed medical condition that is known to affect cognitive ability, treatment to correct that dysfunction can confidently be called therapeutic and is usually uncontroversial. At the other extreme, if a person with no disability who functions well, at average or above average levels of cognition, chooses to try and increase that ability by taking drugs before an examination to improve concentration or memory, this is clearly enhancement. But many situations are less clear-cut, such as interventions in older patients to prevent or delay the onset of mild cognitive impairment. Where the impairment consists of mild forgetfulness, which does not impact seriously on their quality of life, it seems neither therapy in the same way as a hip replacement following a fracture would be nor enhancement akin to having cosmetic surgery to improve appearance. All this indicates, however, is that there are a range of interventions which could be classified as either treatments or enhancements because they provide a desired benefit and are perceived as contributing to human flourishing. With an ageing population, many people expect to be able to enjoy a healthy and active life-style into their old age and, as a result, even relatively minor age-related deficiencies that were, in the past seen as natural and inevitable are increasingly seen as both problematic and avoidable.

For the purposes of the ethical debate in this paper, there is some benefit in distinguishing between treatment for a medical condition or a physiological dysfunction and attempts to improve already healthy individuals. While recognising that boundaries are not always clear-cut, a broad distinction can be drawn between therapy and enhancement in their extreme forms. In this definition, "therapy" is an intervention to counteract a known or an anticipated health deficit. "Enhancement" involves attempts, by healthy individuals, to increase particular aspects of their functioning beyond the norm for that person and in the absence of any identified dysfunction. On the border-line between these two extremes lies memory lapses that are a natural part of the aging process, where this is relatively mild and does not impact seriously on individual functioning but may impair quality of life.

In attempting to distinguish between therapy and enhancement, however, relying on the distinction between "healthy" and "unhealthy" is also problematic as there are differing definitions of health and how it should be measured. Whether an individual is "healthy" is not always a matter of fact but can often be a matter of perception. Even the perceptions of patients themselves regarding their own health can be heavily influenced by various factors, such as their personal expectations about what "good health" entails and whether they think a "treatment" would benefit them. Where good medical care is readily available, people with generally good health often have a higher perception of morbidity and

perceive themselves as needing treatment. Whereas people with poor access to health care often see "health problems as a standard condition of existence and can have a very low perception of being medically ill."[8] Having a diagnosis and therefore a label to attach to how they feel is often the confirmation that patients need in order to confidently assess their own health status. But although much can hinge on having a diagnosis, that too is not necessarily a strictly factual description. There is not a clear-cut distinction between memory loss associated with ageing and the early stages of Alzheimer's disease, for example, and a medical diagnosis of dementia will be provided by different health professionals at different stages. So, there can be considerable variation on what we actually understand by "health". Should "health" be understood simply as the absence of disease – which has been the traditional medical view - or, as the World Health Organization insists, does health encompass a much broader concept of "complete physical, mental and social wellbeing"?[9] For example, if an older person does not have a defined medical condition but has difficulty functioning in a social environment, should this person be considered "healthy" or as having an impairment requiring medical intervention?

## Why does terminology matter?

We may ask whether the terminology actually matters but one reason for trying to clarify it as much as possible is that labels carry certain connotations or preconceptions and so can influence public perceptions. If someone has a condition such as Fragile-X that leads to severe learning disability, treatment to increase cognitive ability, raises none of the ethical concerns that are raised by the use of similar medical interventions for essentially social goals in healthy individuals. Another difficulty with trying to make clear distinctions between therapy and enhancement is the weight this places on the diagnosis. If two individuals have the same level of cognitive ability but one suffers from a known disorder and the other does not, there is a temptation to say that treating the former is therapy but the latter enhancement. This fails to take account of the fact that the second individual may have some undiagnosed disorder and also that the outcome of treatment could be the same for both. Clearly, there is a danger in perceiving one use of technology as acceptable and the other as not, simply based on whether there is a diagnostic label.

If therapy is seen as important and central to the goals of medicine, whereas enhancement is seen as trivial and optional, individuals who want to make use of the technology without being seen as trivialising it are helped by having a medical diagnosis. As a result of having a diagnosed medical condition, they become eligible for "treatment" and also can legitimately claim a range of additional help and support measures. This means that, although having a definable illness has often been seen as socially disadvantageous, in some contexts a diagnosis is an advantage and something that might be actively sought. For example, parents of children with a border-line diagnosis of attention deficit hyperactivity disorder (ADHD) may see practical advantages in their children having a clear diagnostic label so that they can access certain services and benefits. As with any newly identified condition, clinicians' ability to recognise and diagnose it increases with familiarity and so there is a certain inevitability about conditions appearing to become more common when it may only be the case that they are better diagnosed. Nevertheless, it is noticeable that there are some social benefits to an ADHD diagnosis and that in some parts of the United States up to 20% of children are diagnosed with the condition[10]. This has contributed to what has been termed "diagnostic creep" where the diagnostic terminology widens to incorporate a broader definition of what counts as illness or impairment. Cognitive impairment in older people, for example, which may not seriously affect their lifestyle and would previously have been seen as an acceptable aspect of ageing becomes perceived as a condition requiring treatment. What were once seen as social issues and an integral part of life or individual personality become medical conditions for which drugs and other forms of treatment are developed and demanded.

## Internal and external enhancers

A variety of means have always been available to improve cognition by, for example, mental or physical exercise but what we focus on here are specifically medical interventions to achieve that goal. Whenever people use pen and paper to remember something or use a calculator or a computer to gain information they, as healthy individuals, are using enhancers to improve cognitive ability. Although there is overlap, the current debate on enhancement suggests that it is feasible to distinguish between these forms of enhancement and the use of pharmaceutical products or medical procedures. The "external" enhancers such as books and computers are seen as less potentially threatening. Although they can exercise influence or alter a person's mindset, they seem less risky than physically altering the chemical balance in the brain as "internal" enhancers can do. Both types of enhancement can help people to achieve their potential but "internal" enhancers raise concerns precisely because of their aim to alter the functioning of the brain.

## How is "enhancement" used in this paper?

There are clearly difficulties with identifying conceptually or practically compelling distinctions between enhancements and other attempts to improve cognitive ability but that does not mean that no distinctions can be made and we must

either accept or reject all means of seeking to improve cognitive ability. There are some things that our society generally considers to be good – such as the provision of education or the treatment of known disabilities. There are others that we may wish to subject to further analysis and consideration – such as the routine use of pharmaceutical products as "study-aids" by those with no recognised health impairment. In order to have a meaningful debate about where, if at all, boundaries should be set, it is useful to have a broad definition of "cognitive enhancements" to capture the general parameters of that debate, whilst also recognising the difficulty with providing precise definitions and distinctions between the concepts under discussion. For the sake of this paper, therefore, we are making a broad distinction between both therapy and enhancement and between internal and external enhancers. In this paper, we are focussing on the possible future use of internal methods of enhancement by members of the population who do not have a specific medical condition or recognised health impairment.

## PART TWO – HOW MIGHT WE TRY TO ENHANCE COGNITION?

### Nutrition and nutritional supplements

It has long been recognised that good nutrition is essential for the overall health and well-being of the population. Indeed, Hippocrates is credited with being one of the first physicians to recognise that disease was not a divine punishment but rather the product of environmental factors, diet and living habits. Good health is clearly dependent on the combination of many factors but poor quality nutrition during pregnancy and childhood can result in impaired physical growth and development throughout an individual's life. There is also growing evidence to suggest that good nutrition is essential for optimal development and functioning of the brain. Considerable attention has been given, for example, to the possibility of improvements in IQ linked to fish oil supplements – such as omega 3 essential fatty acids. The rationale for this is that 20% of the brain's structure is made of omega 3 long chain polyunsaturated fatty acids (PUFAs) mainly docasohexanoic acid (DHA) which is principally derived from fish oils. Omega 3 is important for the flexibility of brain cells and protects neuronal function. Therefore nutrition is one of the factors that can have a positive impact on cognitive ability. Despite this evidence, the diet of many people in the UK frequently lacks nutrients that are believed to contribute to brain development.[11]

#### Effects of improved maternal nutrition on the fetus

Some research evidence suggests a link between both maternal seafood intake[12] and infant and prenatal supplementation with essential fatty acids and cognitive development in children.

A meta-analysis of the results of 8 randomised clinical trials, undertaken by Cohen and colleagues who extrapolated from supplementation in infants to maternal intake, estimated that increasing maternal DHA intake by 1 gram per day increased the child's later IQ by 0.8 to 1.8 points.[13] In another study, when expectant mothers took omega 3 supplements from 18 weeks of pregnancy and during 3 months of breast feeding, the children's IQ was 4.1 points higher at 4 years of age than those whose mothers had taken omega 6 supplementation.[14] Other factors such as birth weight, maternal age, maternal or paternal education did not differ significantly between the groups.

Omega 3 supplements are now specifically targeted at pregnant women – often being sold in combination with ante-natal multi-vitamin and mineral formulas – as a way of supporting brain and eye development in the fetus.

#### Nutrition in children with learning problems

Much of the research into omega 3 to date has focussed on children with dyslexia, attention deficit hyperactivity disorder (ADHD) or other learning disabilities in whom there is some evidence of improvements in both behavioural and educational outcomes. Unfortunately, however, the evidence is far from clear cut and further research is needed. While a study by Richardson and colleagues carried out in Durham found significant improvements in reading, spelling and behaviour following omega 3 and omega 6 fatty acid supplementation, such results have not been consistently replicated.

The Durham study involved 117 children aged 5-12 years of age with developmental co-ordination disorder (which has significant overlap with ADHD, dyslexia and autism). In a randomised double-blind placebo-controlled trial, children were given either active treatment (omega 3 and omega 6 supplementation) or a placebo for 3 months. After 3 months the active treatment group showed significant improvements in reading, spelling and behaviour compared with those taking a placebo. For example, the reading age of the treatment group rose by an average of 9.5 months whereas the control group rose by only 3.3 months. For the next 3 months the placebo group were also given active treatment and similar levels of improvement were found; the performance of those in the original active treatment group (still taking the supplementation) continued to improve over this 3 month period.[15]

Some other small studies have, however, either failed to find any significant differences between the treatment and control groups[16] or found significant differences in only a small number of the participants.[17]

#### Nutrition and cognition in healthy schoolchildren

Following widespread reporting of studies showing improvements in children with learning problems, and given that essential fatty acids are frequently lacking from the modern day diet, products and supplements containing omega 3 have been heavily advertised to parents as a way of improving learning and concentration in their healthy children. At one stage it was even reported in the media that the Government was considering providing omega 3 to school children

to improve their performance and concentration.[18] While there is no known disadvantage to such a proposal (apart from the financial costs involved and risks of some children being allergic to fish products), it is obviously important that such a move is evidence-based. In fact, there has been very little research undertaken into the effect of omega 3 supplementation in healthy children.

In 2006 the Food Standards Agency published a systematic review of published controlled trials into the effect of diet (including omega 3) and nutrition on learning and educational ability of school-age children.[19] This review found that there was insufficient evidence to reach firm conclusions in relation to such a link in healthy children, principally because of the lack of large scale trials, inconsistencies in study design and the variable quality of the research undertaken (in particular, the failure of many studies to take account of potentially confounding factors such as physical activity levels, habitual diet and family environment). This does not mean that there is no link between nutrition and cognitive ability in healthy children but simply that the evidence is not yet available to prove conclusively that such a link exists. Despite this, there are an increasing number of small scale studies that appear to suggest that good nutrition may have a positive impact on cognitive ability and help to bring people up to their full potential. There is also anecdotal evidence that improving the nutritional value of school meals improves concentration and behaviour among children and young people. This is an area that clearly requires further good quality, long-term studies in order to provide information both for policy makers and the public.

### Nutrition and mental abilities in the older person

Preliminary evidence also suggests that omega 3 might be helpful in slowing cognitive decline in some patients with very mild Alzheimer's disease.

A study in Sweden compared 89 patients with Alzheimer's disease who took omega 3 supplements and 85 patients who were given a placebo.[20] After six months there was no difference in the rate of cognitive decline between the two groups but among a subgroup of 32 patients who had very mild Alzheimer's disease at the beginning of the study, the rate of decline was significantly slower than those who took the placebo. When those with very mild impairment who had been on the placebo switched to omega 3, the rate of decline began to slow.

Although more research is needed, this study suggests that omega 3 may be helpful for a select group of patients with very mild Alzheimer's disease.

### Conclusion

There is clearly considerable interest in the concept of enhancing cognition or slowing its decline through food supplements. Omega 3 has been a particular focus but a number of large scale trials are also underway to investigate preliminary evidence suggesting that dietary supplements of B vitamins, folic acids or food rich in antioxidants can improve cognitive function.[21]

Nevertheless, the evidence for the effectiveness of nutritional supplements in improving and enhancing cognitive ability is equivocal. Whilst there is no doubt that good nutrition is essential to good health, including optimising brain development and functioning, the best way to achieve this is through a balanced, healthy diet. Supplements, such as omega 3, may be useful in those whose diet is deficient but more research is needed to confirm this and also to confirm whether supplementation has any effect in those healthy individuals who receive all of the necessary nutrients for the brain from their diet.

## Pharmaceutical products

Pharmaceutical products have traditionally been developed to treat, prevent or alleviate the symptoms of disease but modern medicine is increasingly occupied with various aspects of lifestyle and aspirations for health unrelated to the existence of disease or impairment. A number of pharmaceutical products have emerged which improve concentration, memory and other aspects of cognitive performance in those who have some level of impaired functioning. Drugs such as methylphenidate (Ritalin), donepezil (Aricept) and modafinil were originally developed to remedy specific cognitive impairments. (Methylphenidate was designed for the treatment of attention deficit hyperactivity disorder (ADHD), donepezil as a treatment for Alzheimer's disease and modafinil for those who suffer from narcolepsy and excessive daytime sleepiness). Many of these products, which alter the chemical balance of neurotransmitters in the brain, also have the potential to improve cognition in healthy people and so there has been much speculation about their use as cognitive enhancers.

Research involving these products was undertaken to develop a greater understanding of the mechanisms that control cognition (its neuromodulation) and the way in which different pharmaceutical products affect performance. The research involved healthy volunteers so that the findings would not be confounded by the patient's underlying condition. These studies have led to growing evidence that, in addition to their intended uses, these drugs can also have beneficial effects on some aspects of cognitive functioning in healthy individuals. In effect, they can improve on some aspects of normal functioning and make people "better than well".[22] With a structure as complicated as the brain, however, it is not surprising that this is not as straightforward as it might sound. Although the pharmaceutical products produce interesting and promising results in ideal laboratory conditions, their impact in less controlled situations is still to be investigated. In the meantime, there are risks in attempting to extrapolate from small scale studies. There is some suggestion that improvements in one aspect of an individual's performance may be offset by decreased performance in another aspect. It must also be strongly emphasised here that the side-effects of taking the drugs, particularly over a prolonged period, are unknown and may turn out to be problematic. Nevertheless, despite the lack of information about the long-term use of such drugs in healthy individuals, there is already evidence of demand. As our understanding of the way the brain functions in relation to cognition improves, it is likely that more drugs, with fewer side-effects, will be developed and that such demand will increase.

## Improving on nature in healthy people

Research evidence has shown improvements in various aspects of cognitive function in healthy individuals.

In a double-blind, placebo-controlled study involving 28 healthy young men, methylphenidate was found to have significant effects on the performance of tests of spatial working memory and planning but not on other aspects of cognitive performance such as attention and verbal fluency tests[23]. Interestingly the performance in the treatment group was much better when the tests undertaken were novel than when the tests were repeated, although response time was decreased in the second set of tests suggesting that, in some cases, increased impulsivity resulted in an increase in errors in some of the tests. So while methylphenidate appears to improve cognitive performance in novel situations, it can also increase the speed of response giving insufficient time to think a problem through and thus reducing overall accuracy.

Improvements in spatial working memory tests among healthy volunteers taking methylphenidate have also been found in other studies.[24] In one of the studies, the increase in working memory was greater in the subjects with lower baseline working memory capacity suggesting that some forms of cognitive enhancements may be of more benefit to those who have a lower starting point than those who already have a high level of functioning.[25] Although most studies have found improvements in working memory and sustained attention with methylphenidate, this has not been universal. One study assessing the effect in elderly male volunteers found no discernible improvements in these aspects of cognitive function.[26]

Cognition is a blanket term covering many distinct features of brain functioning, including learning and memory, attention and executive functions such as the ability to plan. Pharmaceutical products may affect some but not others. There is already a large knowledge base, for example, about specific neurochemicals which affect memory and attention by acting upon the neurotransmitters in the brain that are involved in learning a memory and its reinforcement. Research has shown improvements in aspects of cognitive ability with the use of modafinil in healthy people, including improved attention, performance on complex tasks and logical reasoning among those who are sleep-deprived.[27]

In one study sixty healthy young adult male volunteers received either placebo or modafinil prior to performing a series of tests designed to assess memory and attention.[28] In many of the tests undertaken there was no significant difference between the two groups but in those relating to recall of numerical sequences, visual pattern recognition memory, spatial planning and stop-signal reaction time the results differed significantly between the groups. In all of these tests, those who had taken modafinil performed better than those taking the placebo. In this study modafinil slowed response time but led to greater accuracy of results suggesting that the drug caused the individuals to carefully evaluate the problem before initiating a response, thus improving overall performance. Those who had taken the active drug also reported feeling more alert, attentive and energetic.

As with methylphenidate, the evidence on modafinil does not exclusively show improvements. In a study involving 30 healthy non-sleep deprived students, for example, no significant differences were found in any of the cognitive tests undertaken between two groups who received different doses of modafinil and a control group who received a placebo.[29]

Other drugs have also been suggested as improving cognitive ability in healthy individuals. Airline pilots who had taken donepezil for 30 days, for example, showed greater ability to recall how to perform complex tests on a flight simulator than those who had taken a placebo[30]. Research has also found that amphetamines can improve retention and recall of verbal memory among healthy volunteers[31] (although they also have other less desirable effects) and research is currently underway into the effect of ampakines on cognitive ability.[32]

### Risks and side-effects

With virtually all drugs, there are side-effects. Among the common side-effects of methylphenidate, for example, are: insomnia, nervousness, headache, decreased appetite, abdominal pain and other gastrointestinal symptoms, and cardiovascular effects such as tachycardia, palpitations and minor increases in blood pressure.[33]

Use of prescription drugs is monitored for safety but one of the risks associated with drugs used outside the conventional doctor-patient relationship is of misuse which damages health including the risk of interaction with other medication. Although prescribed use of methylphenidate appears safe, misuse or over-use of any stimulant medication can have adverse or even fatal consequences.[34] There are also risks of addiction when drugs are taken in high doses as a regular aspect of behaviour rather than on isolated occasions to pursue specific academic or career goals. In one study (described below) healthy American students who took Ritalin did so not just in the hope of improving their academic success but also for social purposes such as partying.

The effects of taking such drugs over a long period of time, particularly the effect on the developing brain, are still being assessed. Where the individual suffers from some illness or disability, the benefit of treating the condition or the symptoms offsets the harms of these side-effects; this balance is clearly different where drugs are used by healthy individuals to improve upon normal functioning. Despite this, 79% of the American college students who reported taking Ritalin in the study quoted below had no concerns about their use.

In addition to the side-effects of the drugs, there are other potential risks and what may superficially appear to be an unalloyed benefit may hold hidden disadvantages. Most people are likely to see a good memory as a benefit but there is also the risk of individuals being plagued by unwanted or painful memories. Future pharmacological research may focus on finding ways of deleting such unwanted memories. Drugs which improve functioning after sleep deprivation can also result in excessive wakefulness.

### Demand for pharmaceutical cognitive enhancers

As our understanding of the brain develops and we gain a better understanding of the mechanism of learning, memory, etc so the opportunities for new drug development aimed at cognitive enhancements increase and many new products are currently under development. There is undoubtedly a huge potential market for drugs that enhance cognitive abilities for treating recognised and diagnosed disorders, such as ADHD or Alzheimer's disease. There is a danger, however, that the existence of such a massive potential market may result in exaggerated claims for the benefits such drugs can offer and the minimisation of their adverse effects. Such factors, in turn, could create completely unrealistic expectations in the public mind and contribute to the growing interest for such enhancers amongst those who experience age-related mild cognitive impairment and, quite likely, also among healthy individuals seeking to improve their performance either generally or at specific times or for specific tasks, such as examinations or for particularly challenging work projects. There is already evidence that the use of prescription drugs by high school and college students as "study aids" is not uncommon in the United States.

> In one study, which considered anonymous responses from 1,025 American college students, 16.2% of respondents reported such use, 96% of whom used Ritalin in order to improve attention, partying, reduce hyperactivity and improve grades.[35] When asked about frequency of use, 15.5% of the students reported using the drug at least 2 or 3 times per week. No similar study has been conducted in the UK.

### Summary

There is growing evidence that a range of pharmaceutical products can enhance various aspects of cognitive ability in healthy individuals. Despite the risk of side-effects, healthy people appear willing to use these products in an attempt to enhance their performance. As more drugs are developed that are known to improve cognitive abilities, such as memory, concentration etc, the chance of their use by healthy individuals increases.

## Brain stimulation and neurotechnology

Another procedure developed for research and therapy and that has been associated with cognitive enhancement is brain stimulation. There are two main forms of stimulation in use: transcranial magnetic stimulation and deep brain stimulation.

### Transcranial magnetic stimulation

With transcranial magnetic stimulation (TMS) a brief magnetic pulse is applied over the scalp overlying a particular part of the subject's cortex. It provides a non-invasive way to directly stimulate the brain. It can be applied in a single pulse (sTMS) or repeated pulses (rTMS) – the safety of both has been established and guidelines published but there is a possibility of inducing seizures in some patients when stimulation is administered at high rates and intensity.[36] TMS has been tested in the treatment of depression and Parkinson's disease amongst other conditions with limited success. It has also been suggested that, in the future, it could be used as a form of cognitive enhancement (it has been referred to, for example, as "Botox for the brain"[37]).

In order to gain information aimed at therapeutic interventions and improving our understanding of the way the brain works, a lot of the research into TMS involves disrupting brain activity at specific times and at particular locations.[38] This has some advantages over brain imaging, which can identify which parts of the brain are active whilst performing certain activities but does not determine which parts of the brain are required to perform the task. It is therefore often used as a complementary research tool to imaging. As a result of studying the way in which activities are affected by stimulating different parts of the brain for a short period, it is possible to identify which areas of the brain are required for certain tasks. A lot of useful information has been obtained from this research relating to vision, attention, memory, speech and language.[39] Through this research some preliminary evidence has also emerged of enhanced cognitive performance following stimulation in experimental settings.

In one study involving 15 healthy male volunteers, TMS was delivered to three different areas of the brain that have been found to be associated with language and, as a control, one area associated with vision.[40] Some of the sample also received sham stimulation where the stimulator was discharged in the "wrong" position to deliberately prevent brain stimulation. Immediately after the stimulation and again 2 minutes later, the volunteers were shown 20 drawings and asked to name the objects as quickly as possible. Both the accuracy and time taken to identify the objects were measured. There were no significant differences in the accuracy of naming objects between the groups but those who received stimulation of one of the areas of the brain associated with language (known as "Wernicke's area") had reduced response times immediately after stimulation. This improvement was not, however, repeated when the objects were shown again after 2 minutes suggesting that any improvement was very short-lived.

Another study was seeking to identify whether the left dorsolateral prefrontal cortex (DLPFC) of the brain, which is known to be activated when people seek to solve problems by analogy, is required for, or incidental to, such reasoning. In a study involving 16 healthy volunteers, rTMS of this region led to a significant reduction in response times, compared with sham stimulation, when carrying out tests requiring the ability to identify specific characteristics of the task and identify relevant analogies as part of the process of solving them. Decreased response times were not found to affect accuracy.[41] Reduction in reaction time was also found after rTMS of the left prefrontal cortex (DLPFC) in a study in which 14 healthy volunteers were shown 100 flashes of light – 20% red and 80% white – and were asked to press a button when the red flash appeared. The reduction was significantly greater in this group than when rTMS was applied to the right PFC or when sham stimulation was applied.[42]

Some research has also been undertaken that shows improvements in memory[43] and learning[44] with transcranial magnetic stimulation.

These and other studies, designed to increase our understanding of how the brain works in relation to aspects of cognition, have heightened speculation that TMS may be useful as a cognitive enhancer in healthy individuals. Given the non-invasive nature of the procedure, if significant improvements in memory, learning etc were to be found, and safety issues could be addressed, there may be demand for this procedure – particularly amongst those who are suffering from age-related memory lapses. Such speculation is, however, premature and from existing findings it appears that those who hold out hope for this development may be disappointed. Although research has identified some small, short-lived, task specific improvements in a laboratory setting, this is very different from the significant, long-term, useful improvements that would be required to justify its use in real-life settings and on a population basis. One of the major disadvantages of TMS is that the evidence accumulated so far suggests the effect of stimulation is temporary and usually short-lived after the stimulation has ceased.[45] In addition, TMS has had only limited success with very simple tasks and enhancements have been much more difficult to produce with more complex tasks. There are also difficulties with directing the magnetic pulses to the precise area of the brain that controls the desired activity and that area alone.

Where connecting areas of the brain are inadvertently stimulated this will cause confounding secondary effects. These factors combined lead to serious doubts about any future possibility for transcranial magnetic stimulation as a non-invasive form of cognitive enhancer although this cannot be entirely ruled out.

### Deep brain stimulation

Deep brain stimulation is an invasive procedure involving the insertion of electrodes into the brain through the skull directed at an appropriate part of the brain. A connection is then run under the patient's skin to an electrical pulse generator which is implanted under the skin on the chest, a bit like a pacemaker. The pulse generator sends tiny electrical currents through the electrode to the brain. There are small risks associated with the procedure and in a very small number of patients the operation to insert the electrode has resulted in a stroke. The beneficial effects have been shown to last up to 8 years but longer term effects are unknown. Deep brain stimulation is now a proven therapeutic procedure for some patients with Parkinson's disease and is approved by the National Institute for Health and Clinical Excellence (NICE) for use in NHS patients where drug treatment for Parkinson's disease is no longer able to control the symptoms.[46] It has also been used experimentally to treat central neuropathic pain, such as phantom limb pain, depression, anxiety disorders and obsessive compulsive disorder (OCD) and developments have recently been reported in the use of deep brain stimulation to develop levels of awareness in patients in a minimally conscious state.[47] As with transcranial magnetic stimulation, there has also been some speculation that it could be used as a cognitive enhancer, with deep brain stimulation referred to as "plastic surgery of the mind" and "brain-lifts".[48]

The increasing ability to identify which areas of the brain are associated with, and required for, particular cognitive abilities raises the theoretical possibility of stimulating that part of the brain to either improve or inhibit performance. Because of the invasiveness of deep brain stimulation there are no research projects involving healthy volunteers but studies involving rats have shown some improvements in attention and memory following deep brain stimulation.[49] The success achieved in humans with Parkinson's disease and depression has also demonstrated that stimulating specific regions of the brain can affect behaviour. In addition to the technical hurdles and safety issues that need to be overcome, for such stimulation to work as a cognitive enhancer there would need to be (as with many of the other techniques discussed here) a massive increase in our understanding of the way in which the brain works with far greater sophistication in our understanding of cognition. It is also highly questionable whether healthy people would want, or should be encouraged to want, to have invasive brain surgery, with all its attendant risks, in order to enhance their cognitive ability. We do not know, for example, how stimulation of the brain will affect the mood, character or personality of healthy individuals. Increasingly, however, people appear willing to endure risks, including major surgery, to enhance their visual appearance and so the development of a market for deep brain stimulation to improve cognitive ability – were it to be technically possible – cannot be entirely ruled out.

### Brain-machine interfaces

There has also been some interest in the possible use of brain-machine interfaces and the US Defense Advanced Research Projects Agency (DARPA) is reported to have invested a significant proportion of its research budget into this area of research.[50] As part of this work, electrodes were implanted into the brains of five rats. Using signals sent directly to the brain via these electrodes the researchers were able to train the rats to move right or left, to climb and jump. In another study, which was part of the DARPA programme, rats were taught to control a lever via electrodes implanted in the brain. Advances in the use of this technology have also been reported that aim to assist paralysed patients with communication[51] and movement[52] by finding methods to detect neural signals and then translate them into command signals that can control physical devises such as robotic limbs or can restore physical movement to paralysed body parts. These developments have led to speculation that in the long term brain-to-brain communication could be possible and that this technology could be used to improve the performance of healthy individuals.[53] There are, however, many serious technical barriers and safety issues to overcome and if any significant developments are made in this area, that have potential for cognitive enhancement of healthy individuals, it is very unlikely to be in the foreseeable future.

## Genetic selection and manipulation

### The heritability of intelligence

Intelligence is one of a number of behavioural traits for which there is some evidence to show a high level of heredity. Many studies have been undertaken comparing similarities in IQ between identical (or monozygotic) twins who have identical DNA and non-identical (or dizygotic) twins who share approximately 50% of their DNA. These consistently show that about 50% of variation in IQ within populations is based on genetic make-up, with the remainder made up by

various environmental factors – such as family environment, health, nutrition and educational opportunities.* Studies also show that full siblings resemble each other more closely in terms of intelligence than half siblings, this includes cases where siblings have been living apart from a young age.[54] In addition, children who are given up for adoption before 6 months of age more closely resemble their genetic mothers in terms of IQ than their adoptive parents.[55]

The suggestion of a high genetic contribution to intelligence has caused speculation about the possibility of genetic selection and manipulation as a form of cognitive enhancement. It is currently possible to use in vitro fertilisation (IVF) techniques to create embryos outside the body, remove one or two cells from the embryo and test them for a range of disorders. Using this technology permits the transfer into the uterus of only those embryos that are found to be unaffected by the condition for which there is a known genetic risk – this is called preimplantation genetic diagnosis (PGD). If we knew which genes were associated with intelligence then it has been suggested that it might be possible to use this same technology to select those embryos that are of above average intelligence.[56] Given the invasive nature and relatively low success rates of IVF treatment, it is highly questionable whether there would be any demand for such enhancement, even if it were possible. If, however, PGD were being performed to avoid a serious disorder and there was a microchip capable of testing for a large number of genetic factors at the same time, might people want to include intelligence amongst these tests? This would, in theory, enable parents to select from among those embryos that are free of the disorder, the ones that have the highest intellectual potential. Research indicating that memory and learning can be enhanced through manipulating the genetic make-up of mice has also led to speculation that, in the future, similar forms of enhancement, by genetic manipulation, may be possible in mammals,[57] including humans. So, how close are we to realising that vision?

## The search for genes associated with intelligence

The findings from twin and sibling studies, whilst confirming that both nature and nurture play roughly an equal part in differences in intelligence, provide limited practical information about intelligence and genetics, do not tell us which genes are involved or how these genes might influence intelligence. Furthermore, finding which specific genes affect intelligence is by no means straightforward. Research suggests that the same genes are largely responsible for different aspects of cognitive ability, with a high correlation among different tests.[58] There are many different genes that play a part in the various components of intelligence and each of these is likely individually to have a very small effect (perhaps around 1% of the total genetic component of intelligence). Intelligence is likely to be determined by a complex of range of coactions and interactions between genes and environmental factors. One thing we can say for certain is that there is no single "gene for intelligence".

Some progress has been made in identifying genes that are associated with cognitive functioning. Very many rare gene mutations have been identified that cause mental retardation. One of the commonest affecting perhaps 1 in 2,000 of the population is the gene that causes Fragile-X syndrome where those affected have an average IQ of 50. Research is also underway into the influence of genetic factors on the rate of cognitive decline in elderly patients.[59] However, there is no evidence that the same genes that are associated with mental retardation also influence normal variations in intelligence within the population.[60] Through research involving healthy volunteers, assessing the genetic make-up of individuals with different levels of IQ, various genes have been identified that are thought to have some effect on intelligence in the general population but, so far, these findings have not been consistently replicated by other researchers and so firm information about genes associated with normal variation in intelligence remain elusive.

One study compared the frequency of a particular variation of a gene called IGF2R in 50 children aged 6-15 years old with high IQ (average 136) and a control group of 50 children with average IQ (103).[61] The results suggested that the IGF2R gene was associated with high IQ but this gene had a low effect and accounted for only around 2% of the variation in IQ (this is 2% of the effect among the group and not 2% in each individual since more than half of those in the high IQ group did not carry the relevant variation of the gene).

Although other studies have also found a positive association between IGF2R and intelligence, this finding has not been consistently replicated.[62] Some geneticists have argued, however, that it is only a matter of time (and funding) for sufficient studies to be conducted, with a large enough sample size, to provide clear evidence of a number of genes that have an effect on intelligence. In many ways, however, identifying the relevant genes is the beginning, rather than the end, of the story.

* This does not mean that 50% of an individual's intelligence is determined by their genetic make-up but that 50% of the variation in intelligence within groups is a result of genetics.

## The application of genetic knowledge

Before there is any hope of these genes being used for selection or manipulation, it is essential to know how they affect intelligence, how they interact with other genes and the environment and what other functions or effects those genes have. It is almost impossible to believe that those genes would be specific to intelligence, in terms of affecting only that trait. In fact, some of the genes that have so far been identified as having a possible association with intelligence are also associated with other traits, including some positive and some deleterious ones such as an increased sensitivity to pain[63] or a predisposition to cancer.[64] Even if it were possible then to select embryos that carry a range of genes associated with increased intelligence, or to use genetic manipulation to insert those genes, it is highly questionable whether this would be desirable given that this may make the individual more susceptible to one of those conditions. Of course, it is impossible to identify every effect a particular gene will have, particularly given the added complexity of gene-gene and gene-environment interactions, and there will always be unknown risks to taking such action. Unlike with selection or manipulation to avoid or cure a serious disorder, the "benefit" to be accrued from enhancement may never be sufficient to justify taking these risks. So there are not only technical but also serious safety barriers that are likely to hinder the use of genetic manipulation and/or selection as a form of cognitive enhancement.

Nevertheless, opinions differ about the likelihood of these technological barriers being overcome in the future. The Nuffield Council on Bioethics, in a press release to launch a new report in 2002, whilst acknowledging that there are currently no practical applications of research in the genetics of behaviour within the normal range, nonetheless speculated that "it may be possible to select embryos which are more likely to have a particular trait, such as above average intelligence".[65] The report itself concluded that "future applications with regard to intelligence in the normal range cannot be ruled out."[66] In 2004, however, the Human Genetics Commission took a less optimistic line about the likely direction and progress of future research in relation to embryo selection and genetic modification for the purpose of enhancement, saying:

> *"There is sometimes a belief that in the near future, we will be able to enhance our children genetically and be able to select for certain characteristics such as beauty, intelligence or sporting ability. As HGC has heard, at the moment scientists know almost nothing about which genes might be involved in making up these characteristics and the role of the environment. Even if scientists did know this, an additional problem with selecting for such attributes would be that an impossibly large number of embryos would be required to find one with the desired genetic make-up. An even more remote possibility is enhancement through genetic modification of embryos or fetuses. As with embryos, we have almost no idea of which genes to target or the means of changing them. Any such approach remains science fiction for the foreseeable future."*[67]

## PART THREE – WHAT ARE THE ETHICAL AND SOCIAL IMPLICATIONS OF COGNITIVE ENHANCEMENTS?

### The balance of benefits and harms

With any ethical analysis an important concept is the balance of benefits and harms for all parties. In analysing an ethical dilemma, an important step is to gather information from the perspective of all relevant parties before subjecting them to a thorough and robust critical analysis to consider what weight should be given to the various different interests and duties where they conflict.[68] This section begins this process by considering the benefits and risks of cognitive enhancement both from an individual and a societal perspective. Some of the issues highlighted in this section are discussed in more detail later in the document.

John Harris makes the point that "if it wasn't good for you it wouldn't be enhancement" arguing that "in terms of human functioning, an enhancement is by definition an improvement on what went before."[69] Although this claim is intended to support the view that we should accept cognitive enhancements, interpreted in that way, it simply begs the question of whether "cognitive enhancement" is, in fact, the right terminology. So this observation does not avoid the need to consider whether these developments are, in fact, good for us, as individuals and as a society by assessing what constitutes a benefit, what factors make up a "good life"[70] and who should decide. We have used the term "cognitive enhancement", however, in a literal rather than in a judgemental way – to refer to a range of technologies that are literally aimed at enhancing (or improving) our level of cognition in a way that can be measured. This does not imply that an enhancement is necessarily "good" but rather that it succeeds in improving some facet of mental functioning. Improving our faculties may well be a good thing but enhancing an individual's sensitivity to pain or light or sound, for example, could be profoundly debilitating. Therefore, there may be situations in which enhancement is a good thing and others in which it is not. Enhancement (or improvement) in one area may also directly lead to a reduction in performance in another, or an enhancement may come at great cost to the individual or to society, such that the overall balance of benefit and harm results in a net loss.

#### Individual benefits

In order to begin to assess whether there is net benefit from cognitive enhancement from an individual perspective, we need to consider, in more detail, the ways in which people might benefit from improving their cognitive ability. The level of benefit for any given individual is also an important consideration but this is far more difficult to assess in the abstract, since it is likely to depend upon the particular individuals' own goals and aspirations and the way they see themselves and their place in society.

##### *Positional benefits*

Modern-day UK society is highly competitive – with children judged from a young age on the basis of success in tests and examinations, competition for university places, for openings in prestigious and highly paid professions and pressure to succeed in one's chosen pursuits. In such an environment, it is perhaps not surprising that anything that gives an individual a competitive edge over his or her peers is seen as beneficial. This is what is known as a "positional benefit" in that the benefit arises from improving one's position compared to others. An individual who uses cognitive enhancements to improve his or her performance, in an examination or work setting for example, would gain an advantage over others who do not use those methods (although the impact of that advantage will also depend on their relative starting positions and the extent of enhancement achieved). This benefit relies, therefore, on the use of this technology not being available to, or used by, everyone (and this in itself raises issues of equity which are discussed in more detail below). If everyone used the same method of enhancement, and was enhanced to the same extent, there would be no personal competitive advantage: the baseline would simply improve but individual differences would remain the same. There may, however, be benefits for society from such overall improvement.

##### *Intrinsic benefits*

The advantages an individual might gain from cognitive enhancements are not, however, limited to these positional benefits; there can also be intrinsic value in improved cognitive ability. An individual's cognitive ability, for example, influences many key life outcomes. There is a strong correlation between IQ and factors such as how much individuals earn and their success at work, although much of this could be due to the competitive advantage achieved by their higher intelligence. (The correlation may also be partly the result of other factors, such as the intelligent individual's ability to demonstrate certain culturally desired attributes or the fact that the test of their IQ was merely designed to assess those attributes.) These life benefits go beyond what might be considered purely "competitive" advantages, however, since studies appear to show that those with higher cognitive abilities are also less likely to suffer from a wide array of social and economic misfortunes and are likely to enjoy better health.[71] There is also an extent to which we place value on thinking and understanding as "goods" in themselves. The ability to understand and appreciate the arts,

to grasp the complexities of philosophical reasoning or to have a greater awareness of the issues that affect the world we live in are skills that are considered positive in and of themselves. Even more mundane, everyday activities such as being able to complete a difficult crossword or to solve the most difficult Sudoku puzzle can give us a feeling of pleasure and personal satisfaction.

*Instrumental benefits*

There are also instrumental benefits of improved cognitive abilities. In our lives we all, at times, have difficult problems we need to solve or complex financial or legal matters we need to deal with and being able to think and reason more effectively would improve our ability to resolve these issues. We also all suffer from occasional lapses of memory, such as misplacing glasses or keys or forgetting words, and these incidents become more common as we age. Whilst such lapses do not seriously impede our quality of life, they can be extremely frustrating and disruptive and many people who suffer from this consider the impact on their lives is too easily dismissed and trivialised. Many people in their later years who are not suffering from any diagnosed medical condition may nonetheless see considerable personal benefit in being able to use cognitive enhancements to get over these problems.

Individuals are also members of society and so where there are societal benefits from cognitive enhancement (see below), these will also bring personal benefits to those individuals living within that society.

## Individual harms

Most medical interventions involve some degree of risk. In some cases – such as some forms of chemotherapy – the risks are very high, whereas in others – such as commonly used pain killers – the risks are relatively low. Where treatment is provided to cure or manage the symptoms of a medical condition, the balance of risks and benefits is usually in favour of treatment. Where the alternative to risky chemotherapy is death, for example, the chance of survival despite the side-effects of the treatment is, for most people, the preferable option. With enhancements, the balance is very different: the alternative to treatment is "normality", however that is defined.

*Side-effects*

As highlighted in the previous section, different forms of cognitive enhancements come with different levels of medical risk. While attempts are being made to develop pharmaceutical products that enhance cognitive ability with minimum side-effects, experts in the area warn that "it is very difficult to be certain about the potential for subtle, rare or long-term side effects, particularly in relatively new pharmaceuticals".[72] There may also be particular risks for children and young people who take such drugs while their brains are still developing.[73] There has been some speculation, for example, that healthy individuals who use cognitive enhancing pharmaceuticals in their youth may benefit in the short-term but may then become more susceptible to premature cognitive decline in their later years.[74] We simply do not know what the long-term effect of the use of such drugs in healthy populations will be and whether there will be such a trade-off to be made. Similarly, evidence from brain stimulation and manipulation techniques in patients with conditions such as Parkinson's disease can help to quantify the nature and likelihood of risk and side-effects in those patients but cannot give definitive information about the effect of using the procedure on a healthy brain. Considerable uncertainty also applies to the effect of selecting or manipulating our genetic make-up since, as discussed in the previous section, it is highly improbable that particular genes are specific to aspects of cognitive ability. Evidence has already been found to show that some genes that have been linked to aspects of intelligence also predispose the individual to medical conditions such as cancer.[75]

*Unintended consequences*

Some commentators have also pointed out that the idea that "cognition is good, so increased cognition is better" may turn out to have unintended consequences and that the assumption that "memory drugs will simply increase the amount of memory we have available, leaving all other cognitive and affective processes unaffected" may be incorrect.[76] In fact, our brains selectively filter out some information and memories, particularly those that are trivial or traumatic and we do not know whether drugs to enhance memory will impair this important function. There may therefore be a risk of "over-enhancement" – of being plagued by unwanted and traumatic memories that cause us distress and possibly psychological harm. Or, oversupply of memory could overload the memory system so that, ironically, our ability to perform complex cognitive tasks is, in fact, impaired defeating the object of the exercise.[77] Some people have suggested, however, that if harm results from enhancement, the use of cognitive enhancements would become self-limiting as people learn when it is and is not appropriate and safe to use enhancers.

There may also be a downside to the successful use of cognitive enhancers to improve performance. Once success is achieved, there may be increased pressure on the individual to continue using the drug to maintain that level of performance and this could lead to an increase in dependency and addiction.[78] Another unintended consequence of the use of cognitive enhancements could be to increase pressure on individuals to subscribe to the 24/7 society, to work

harder, longer and more intensively and so it could, in fact, end up exacerbating one of the very problems it was intended to solve.

*Other enhancement techniques*

The use of medical procedures that carry risk for purely elective purposes is not novel. The increasing use of cosmetic surgery – such as Botox, face-lifts or breast augmentation or reduction – is a common example of where people are willing to take medical risks for the sake of enhancement: because for them, the benefits of improving their appearance outweigh the risk of harm. Even though many in society may worry about such trends, provided the people choosing such interventions, have sufficient, accurate information and are competent to make a decision, they are not prevented from doing so. Nevertheless, it is not merely a matter of choice alone and society does attempt to limit the risks, by for example, setting standards, licensing practitioners and forbidding products or treatments which are demonstrably dangerous. Should the same apply to cognitive enhancement? In a society such as the UK, which has a strong sense of personal autonomy and of allowing people to make the decisions that are right for them, are there good reasons to prevent informed, competent adults from making these decisions for themselves based on their own assessment of the medical information, their own goals and ambitions and the level of personal benefit they would derive from enhancement? After all, we do not stop people from participating in risky sports – such as mountain climbing or motor racing – where there are clear health risks. If the risks of cognitive enhancement are no greater than some of these pursuits, what grounds are there for restricting people's ability to make their own decisions about the relative benefits and risks?

When considering this fundamental question, there is an important difference that is worth noting. The brain is an extremely complex and sensitive structure of which we still have only a partial understanding; this means that the risks of intervening are inevitably greater with an increased likelihood of unanticipated problems. This high chance of unanticipated side-effects raises questions about our ability to provide sufficient information to allow people to make informed choices – is it sufficient to tell people that there are likely to be unanticipated side-effects and allow them to make decisions on that basis or should these decisions be taken out of their hands, for their own benefit? The brain is also closely linked to our sense of identify and of self; does interfering with the brain in this way carry the risk of making inadvertent changes to our personality and, in a more philosophical sense, our understanding of who we are? This is discussed in more detail below.

*Looking to the future*

Of course, this paper is looking to the future and, as our understanding of the brain and the way it works increases, it may become possible to some extent, not only to quantify but also to minimise the physical risks of such interventions. It is feasible that some methods of enhancement will be discounted as being too high risk, or too uncertain, for use in the healthy population but also that for other methods, the risks will be reduced to a level that might be acceptable to many people. Although there will always be some residual uncertainty about long-term use, this is no different from other forms of medical treatment such as cosmetic surgery which, although the subject of some controversy, is in common use. It would be naïve and short-sighted to assume that we can dismiss any demand for cognitive enhancements on grounds of safety and we should at least anticipate a time, in the not too distant future, where such interventions are not only available but are also reasonably safe.

## Societal benefits

As the saying goes, "no man is an island" – what happens on an individual level can also affect others, in both a positive and a negative way; the use of cognitive enhancements is no different in that respect. Attempts to improve cognitive ability by individuals can also have an impact on society and these effects also need to be brought into our consideration of benefits and harms.

*A better, more successful and safer society*

Society undoubtedly benefits from the pursuits and successes of its individual members. Highly intelligent and skilled scientists, politicians and doctors, for example, use their skills for the benefit of mankind: inventing new drugs or therapies, curing the sick and finding ways of changing our lives for the better. We all benefit collectively from these skills – so wouldn't it be better for society if there were more people who had the necessary intellectual ability to pursue and advance these goals? Clearly, however, it is important not to over-state the role of cognition, which we said at the outset, cannot, in real life, be separated from other aspects of personality. An individual with brilliant intellectual skills may not necessarily be happy and could still be prejudiced, intolerant or socially inept. Nevertheless, universal access to enhancing interventions would bring up the base-line level of cognitive ability, which is generally seen to be a good thing and is one of the key aims of our ongoing attempts to improve and develop the education system. An overall increase in cognitive ability in society could also lead to competitive advantages in the cut and thrust world of international trade

and commerce. Fukuyama, who vehemently opposes the use of enhancements nevertheless acknowledges that "a society with higher average intelligence may be wealthier, insofar as productivity correlates with intelligence".[79]

Because we literally put our lives in the hands of some professionals – such as airline pilots and doctors – we are also all at risk in the event of human error. Occasional reports of mistakes by exhausted workers after long shifts remind us of the fallibility of human nature. The use of cognitive enhancement to reduce this possibility, by promoting wakefulness and improving concentration, may have wide-ranging benefits including, in some cases, saving lives. There are already reports of modafinil being used to improve performance and safety among one group of professionals for whom errors or lapses of concentration can have dire consequences. There are many reports of such use by US military personnel,[80] for whom concentration, cognitive and physical performance can, quite literally, be matters of life and death. Harris reports that "the cocktail of choice for military pilots is apparently amphetamines on the way out to hype them up for combat and modafinil on the way back to keep them awake and alert to get home safe."[81]

#### *A fairer, more equal society*

The effect of any technology is dependent on how it is used. Cognitive enhancers could be used as a way of reducing some of the inherent inequalities within society.[82] Equality of opportunity is an explicit goal of our education system, giving individuals the best chance of achieving their full potential and of competing on equal terms with their peers. Selective use of the technology amongst those with lower intellectual capacity, or those from deprived backgrounds who do not have the benefit of paying for additional tuition, could enhance educational opportunities for those groups and help to achieve this ambition. As discussed in the previous section, there is some evidence that those with a lower starting point may in fact gain more advantage from some pharmaceutical interventions[83] than those who start off with a higher capacity and so even if such enhancers were to be made universally available, those who would normally be disadvantaged may receive greater benefit. In addition to the individual benefits this would bring to those people, it could lead to a fairer, more equal society.

### Societal harms

Earlier in this section we asked the question of whether there are grounds to deny individuals treatments or procedures that they perceive will benefit them, if they are informed of the risks, including the risk of unanticipated side-effects, and willingly accept them. That question presupposes that it is only the individual who may be adversely affected by such decisions but in the same way that there are potential societal benefits, there are also potential harms to society that need to be brought into the equation.

#### *Increased inequality and coercion*

Whilst cognitive enhancement may be seen as providing positional benefit to individuals, it can also be perceived as reinforcing a competitive and individualistic culture which can be detrimental to society. Rather than encouraging co-operative behaviour that contributes to a fair and decent society within which everyone can flourish, the focus is on individual success and gaining a competitive advantage over others.

One of the potential benefits to society mentioned above was that cognitive enhancements could be used to increase equity and fairness, but the opposite could also be true. One of the strong concerns expressed by many commentators about the use of cognitive enhancements is that it will increase inequality because it will be available only to those who are willing and able to pay. This is discussed in more detail below.

Another concern that is also discussed below, is that what might begin as an individual decision and a matter of free will very quickly becomes expected and then demanded of people.

#### *Unintended consequences*

Some of the unintended consequences of enhancement that are mentioned above as individual risks are also likely to have an impact on society as a whole. It could contribute, for example, to an epidemic use of psycho-pharmaceuticals, beyond the specific disorders for which they were designed, incurring consequent financial and social costs for society as a whole. The impact of an increase in addiction or in psychiatric illness caused by the burden of traumatic memories, for example, would go beyond the individual to their family and friends and to the wider community in terms of the increased risk of social problems, lost productivity and the costs of treatment. Similarly increased pressure to work harder and longer has implications beyond the individual and can lead to family discord and breakdown which, in turn, can lead to social problems.[84]

Widespread use of cognitive enhancers that has the effect of improving the base-line intelligence in society may have positive effects but, as a society, we do not need only very highly intelligent people, we also want individuals to be caring, co-operative and attentive to the needs of others. The highly competitive environment that the use of cognitive

enhancers encourages may, in fact, hinder the development of caring attitudes because of the strong emphasis on individual gain.

it has also been suggested that an unintended consequence could be an increasingly homogenous population[85] that could rid us of the riches of cultural diversity and individual talent and flare.

### Assessing benefits and harms

When assessing benefits and harms, it is not simply a matter of counting up the number of benefits and harms in order to calculate a net benefit figure. Some benefits, and some harms, will be more important or serious than others. It is important to assess what weight should be given to each and make a judgment about their relative merits. When assessing harms it is also important to recognise that terms such as "minimal risk" can be understood in different ways. It can mean something which involves a small risk to a very large number of people or a small risk of a very serious harm to a few people. So, it is not just the seriousness of the risk but also the likelihood of the risk occurring and the number of people affected.

## Equity, coercion and pressure

### The concept of equity

When considering the issue of equity in society, we need to note at least two facts. First, although we may desire equity in society, the existing social order can only provide it in limited circumstances and new technologies may not radically alter prevailing social patterns. Secondly, when we consider the impact of the new technologies, we need to remember that a wide range of social factors directly or indirectly affect health, welfare and social success. Merely to focus to one, such as an individual's cognitive abilities, ignores the fact that many different social determinants affect individuals' ability to thrive physically and psychologically and to succeed socially. Nevertheless, for the purposes of debate, in this section we only try to examine how the ability to enhance a person's cognitive skills might lead to greater or lesser equity overall. Questions of equity might first come into play when we consider who should be able to access enhancement technologies and on what basis – should it be access based on wealth alone or on ability to benefit personally or ability to provide benefit to the wider society? Secondly, once people are cognitively enhanced, will their abilities disrupt any existing measures designed to promote equity and success based on merit within the educational system?

Assuming that equality of opportunity is an important value that we wish to safeguard, society has several options in relation to providing access to enhancement techniques. One choice would be to prohibit them for everyone in all circumstances. Alternatively, we could try to make them equally accessible to everyone who wants them by subsidising those who cannot afford them. Or we could limit and regulate the situations in which they could legitimately be used, particularly within the educational system.

### Equity in health services

Some commentators perceive a threat to the concept of equity if a market-driven approach to neurotechnology and cognitive enhancements develops. Racine and Illes, for example, argue that "enhancement could jeopardize distributive justice and cloud the meaning of medical intervention in modern societies".[86] In their view, the increasingly sophisticated marketing of drugs and techniques will put pressure on individuals who want to succeed and disadvantage people who cannot afford them or object to their use. The wealthy and those willing to experiment will have more choice in how they seek intellectual advantages. While we cannot ignore such anxieties, they are not essentially new, as the wealthy invariably enjoy more privileges, whether it be in the form of books, computers, personal tuition or new technologies. One option would be to avoid adding to existing inequities by banning cognitive enhancement for everyone. Some argue, however, that unequal distribution alone cannot be a reason to reject such techniques as we already accept as inevitable countless examples of unfair distribution of resources. Furthermore, banning them would not necessarily be effective or beneficial to society. Harris points out how in the past books and manuscripts were rare and only available to an elite. Had society banned them because they were unavailable to all, that would have benefited nobody. "It is doubtful ethics to deny a benefit to some unless and until it can be provided for all. It is also doubtful economics and doubtful policy"[87] In fact, by pioneers purchasing new technologies, those goods are likely to become cheaper and more commonplace. So would it be more equitable to give the new techniques to everyone who wants them?

Turner and Sahakian point out that in some respects, those who want them already seek them. If we aspire to prohibit stimulants on grounds of inequity, the battle is already lost as "thousands of normal healthy adults and children have on their own discovered the benefits of cognitive enhancement with many people already self-medicating, using over-the counter remedies such as herbal stimulants, tonics and caffeine, to improve performance at work, school and leisure."[88] Furthermore, although there are recognised risks of buying medication over the internet, agents such as methylphenidate

and modafinil are known to be obtainable in this way. So has the concept of equity, in the sense of people abstaining from stimulants in order to achieve success by sheer effort alone, already been lost and, if so, does that matter given the existing levels of inequity? If we assume it *does* matter and that it would be wrong to abandon our aspiration for equity by creating more opportunities for unfairness, we could consider methods of making enhancing techniques more widely available to everyone. Obviously, there would be a duty on government to first verify the safety and efficacy of the techniques, as well as assessing the likely impact of widespread use on society's values. Nevertheless, it might be argued, for example, that society has a duty to counter-act the concentration of privilege in one stratum by subsidising access by the poor to the benefits that the wealthy can afford. Bursaries, scholarships and grants have long sought to widen access to education among those who are less financially advantaged and could be expanded to purchase new technologies. Given what we have said previously, however, about the multi-factorial nature of health and well-being, this is probably too simplistic a solution. Improving equity in this sphere would also need to take account of the other important social determinants, which not only affect health but also affect individuals' success in society.

As another alternative option, in order to promote equity, we could try to ration access to cognitive enhancement rather than leave it to market forces. Priority might be given to those who could benefit most from the technology or who were in a position to benefit society most if their intellectual skills were enhanced. In theory, such a system of positive discrimination could act as a counter-balance to the privileges of the wealthy and so promote greater equity, but would it be likely to do so in practice? The UK has experience in rationing in the interests of fairness and measures are already in place to prioritise access to benefits such as publicly-funded healthcare on the basis of "need". But we also permit a two-tier system whereby patients who can afford to switch between the NHS and private sector can gain advantages. Therefore a system of rationing based on devoting resources mainly to those who could most benefit from cognitive enhancement would not necessarily eliminate a two-tier system emerging but that might still be preferable to a one-tier system where access to enhancement is based solely on wealth. What people also often worry about with a two-tier system is that specialists and professionals might be lured into providing services in the more lucrative private sector to the detriment of the publicly-funded sector. With cognitive enhancement technologies, there might be the additional worry that health professionals might be more attracted to work in that sector, deserting jobs concerned with the provision of more routine and basic health services. Therefore the very existence of services to improve cognition might undermine the provision of therapy for mental impairment by creating gaps in mental health services, which are already often seen as under-staffed or under-funded.

In some areas of social activity, such as sport, safeguards are imposed to minimise inequitable advantages. Regulatory organisations closely monitor the stimulants used in competitive situations. A question arising throughout this document is whether we should allow people to choose for themselves in most situations but in some circumstances where we think we have achieved a level of equity we strive to maintain that. So, in an intellectually competitive environment such as an examination, should cognitive enhancers be banned to preserve equity based on natural abilities, in the same way as performance enhancing drugs are in competitive sports?

### Equity in education

Earlier in Part Three, we have suggested how in a competitive society, "positional benefits" could be gained by people who obtain cognitive enhancement. Clearly, such benefits could be seen as the antithesis of equity in the educational context, unless used by everyone. In this present section, we have focussed primarily on equity of access to medical services providing cognitive enhancement but, as implied in the earlier discussion, questions of equity continue to arise and become even more acute once people have become cognitively enhanced. Would "enhanced' school pupils, for example, have a negative effect on the classroom atmosphere or quality of teaching, as their quick grasp of subjects left them bored by the pace of their "unenhanced" fellow students? Ultimately, could enhancing technologies disrupt the educational system or distort its priorities by focussing more on intellect alone rather than all-round abilities?

### Coercion

Another concern is that, if available, cognitive enhancements would not be a matter of free choice but people, especially those in vulnerable situations, would be subject to pressure to use them and possibly stigmatised if they do not. As autonomy is highly prized, societal pressure to conform to certain set norms is often seen as objectionable unless it can be justified in the public interest. Obvious questions arising here are whether coercion of individuals might be in society's interests if it significantly improved community safety and whether it is possible to produce concrete evidence of better safety to justify imposing cognitive enhancements on certain sectors of workers. But even if solid evidence is unavailable, society might still consider that some measures could be imposed in the *probability* that it would improve public safety. Although they are not of the same order as cognitive enhancements, we already impose some health measures on some workers for the public good. For example, it is obligatory for certain healthcare workers entering the NHS to undergo immunisations against conditions such as Hepatitis B and testing for HIV and TB. Routine health checks and restrictions

are also imposed on HGV drivers and pilots. If it were estimated that public health risks would be minimised by making cognitive enhancement a requirement of the employment contract in certain sectors, would that be perceived as overly invasive or just another obligation for individuals choosing that career?

*Who might feel coerced: politicians and military leaders?*

If cognitive enhancement came to be seen as essential for success in public life, politicians and leaders would come under pressure to utilize it. There might be strong public interest arguments in even making it compulsory for them if it could be shown that enhancement technology could lead to better reasoned decisions on issues of national importance. The potential military uses of cognitive enhancement are already of interest to governments, not only for leaders but also to maximise the performance of any armed forces' personnel in action. If enhancement technology is available to one side in a conflict, there is inevitable pressure for other armed forces to impose it. The American Defense Advanced Research Projects Agency (DARPA) has been looking into aspects of how brain function could be improved or expanded since the early 1990s.[89] Many different strands of research are said to be under investigation and although some of the projects currently appear outlandish, others may become accepted, and even obligatory, practice

*Who might feel coerced: doctors?*

If cognitive enhancement techniques were only accessible via health professionals, doctors would be pressured to meet patient demand for them. These are already familiar pressures, however, as better informed patients increasingly know what interventions are available and their rights to them. Nevertheless, there could be extra dilemmas for health workers if rationing decisions have to be made, not least due to the previously mentioned difficulties of distinguishing clearly between "therapy" for those who see themselves as ill and "enhancement" for those who just want to improve their performance. Doctors might also come under pressure to have cognitive enhancement themselves as they are seen as having ethical obligations to take all reasonable steps to reduce risks for patients. Health professionals are already obliged to comply with certain invasions of their freedom by undergoing immunisation in order to provide a safe service to the public. Their ability to cope with long hours and the growing complexity of treatments may be seen as requiring additional aids to their concentration and memory.

*Who might feel coerced: employees?*

Other professional groups might also come under pressure if it were perceived as possible to raise public safety standards by obliging them to demonstrate consistent standards of concentration, judgement and alertness. It would be rational to consider this if accidents and errors could be avoided and significant numbers of lives saved. Pilots, air traffic controllers, train drivers and anyone supervising heavy machinery might come under such pressure. If cognitive enhancements were obligatory, there would need to be some supporting evidence to justify invading the liberty of such employees. It is unclear where such data would come from but presumably the kind of data collected by public enquiries into disasters or by coroners might indicate where inattention by individuals contributes to avoidable errors of judgement.

*Who might feel coerced: parents?*

Fukuyama argues that the ability to enhance intelligence may superficially appear to provide some benefits for society as well as for individuals but the gains are illusory. In his view, if every parent tries to produce more intelligent children, this would simply raise the standard at which intelligence is judged so that everyone is obliged to use the technology or fall behind. "People want smarter kids so that they will get into Harvard, for example, but competition for places at Harvard is zero-sum: if my kid becomes smarter because of gene therapy and gets in, he or she simply displaces your kid."[90] Society as a whole does not significantly benefit in his view, rather it is harmed. For the parents, however, there would still be a strong advantage in ensuring that it was their child rather than their neighbour's who attained the limited university place. So, those who could afford the interventions for their children would have a competitive advantage. The result may well be pressure on parents to choose cognitive enhancers and those who abstain risk holding their children back. The question arises as to whether this is any different to parents being able to pay for other educational aids such as one-to-one private tuition or whether it represents an invasion of the child's own sphere of choice, disproportionate to the anticipated benefits? This is discussed further in a subsequent section.

*Who might feel coerced: everyone?*

Although many people have misgivings about the apparent trivialisation of medicine when procedures such as cosmetic surgery – which are not risk-free – are portrayed as standard options to counteract ageing or are given to young people as game-show prizes, we as a society do not prohibit them. Such activities are sometimes perceived as innocuous since they primarily affect the individuals who choose them although there is also the risk of society becoming overly obsessed with images of perfection and so less tolerant of people who look different. It could be argued that as cosmetic enhancements become increasingly common and widespread, fashion and peer pressure make it difficult for some people to avoid having them. Some might say that this is already the case in some careers where good looks are at a premium and signs of ageing mean that a contract is not renewed for a celebrity promoting a brand of cosmetics or

perfumes. Nevertheless, the risks and pressures involved are not yet deemed sufficient to invoke the public good to restrict cosmetic enhancements. Both the risks and the pressures involved in methods of cognitive enhancement, however, are perceived as more significant. Therefore can arguments be made for restricting or regulating access to them, even for competent and informed adults? On the other hand, if greater public debate were generated around the issue of cognitive enhancement, this might lead to deeper public understanding of the nervous system, the causes of neurological and psychiatric illness and the benefits and limitations of different therapies. This might eventually result in more rather than less tolerance of people who are different. More informed debate could conceivably lead to less rather than more pressure to use cognitive enhancement if individuals understood more about possible disadvantages as well as potential advantages.

### Is pressure necessarily bad?

This section covers both societal pressure – which individuals may choose to reject – and coercion whereby the choice to refuse is effectively taken away from certain professions. One of the skills we expect people to develop is an ability to cope with the inevitable pressures that arise in life and put them in context. Peer pressure to conform to certain behaviours is an integral part of growing up. One way of dealing with it, is by society promoting the concept of choice, ensuring that impressionable people have various models of behaviour open to them. If we perceive the risks of pressure as both great and undesirable in relation to cognitive enhancement, society could take steps to counteract it by highlighting and rewarding diversity and talent which is not dependent solely upon intellectual ability. Many of the celebrity role models in the media are not famed for their cognitive skills or intellectual prowess, demonstrating that it is not essential to bow to the pressures to be clever.

Coercion is clearly more threatening to our traditional values than the concept of pressure and many people are likely to find it repugnant even if the results might benefit society in other ways. If lives could be saved by the imposition of cognitive enhancers on key professionals, would that seem justifiable? Clearly, the risks associated with coercion and pressure need to be considered in the context of the procedures we are debating which are designed to work directly on the brain and therefore could affect aspects of individuals' personality and ultimately the nature of society itself. One of the fears expressed by some critics of cognitive enhancement is that the techniques would alter the basic fabric of human life. This is discussed further below.

## Aspiration, effort and authenticity

Apart from the admittedly important questions about equity and distributive justice, we generally have few ethical dilemmas about humanity's inventiveness to make life easier and more comfortable with each generation. In some of the arguments against cognitive enhancement, however, there is a strong sense that intellectual success cannot be valued, if not worked for. Virtues such as persistence, dedication and willingness to strive hard for one's goals might disappear if success required no effort. It is true that the work ethic instilled in many people leads us to place a high value on achievement gained through effort and commitment. In the same way that the Prozac debate in the early 1990s, fuelled arguments about "happiness pills" that could make people "better than well" but were seen as anaesthetising people to the realities of life, so the possibilities offered by cognitive enhancement generate debate about cleverness pills making things too easy. By this measure, "success" – especially if gained through the clandestine use of measures unavailable to potential rivals or competitors – may be seen as a kind of cheating. Something is only generally regarded as cheating, however, if it is against defined rules. If there are no rules about the use of cognitive enhancements, it is questionable whether it can be regarded as cheating. Also, although some people might consider it a form of cheating for a child's parents to purchase additional tuition in advance of an examination, others simply see it as good parenting, even though it provides a competitive advantage not available to all. Furthermore if, as suggested above, either everyone were given access to techniques to enhance their cognitive functioning or regulations were imposed in some situations, the "cheating" element could be removed.

Kass argues that "personal achievements impersonally achieved are not truly the achievements of persons"[91] and the implication is that some important authenticity is lost. Harris responds to this argument by pointing out that we do not generally condemn artificial aids such as calculators or computers that provide accuracy without undue effort but that human judgement and work will still be required. Cognitive enhancement is not a universal panacea that will remove all the need for application and perseverance. "If I take a pill which improves my memory or powers of concentration, I will still have to study, draw conclusions, formulate ideas, or write books for which I may take appropriate credit or blame: credit for the work and ideas but not for the powers of concentration or memory that helped me to those achievements".[92]

## Humanity and personal identity

If improvements could be achieved relatively painlessly and voluntarily through cognitive enhancement, it would be irrational to oppose them. Yet whenever it is discussed, there is a lurking suspicion that – even if achievable – improvement would not be without some profound cost. Debate about what precisely those costs might be often centres on questions about humanity, personal identity and dignity. Fine-tuning our cognitive functions by chemical means is seen by some bioethicists as part of a wider assault on our humanity. Their arguments reflect the view that artificial measures offer only superficial improvement and cannot be labelled as a genuine enhancement because they come at a high cost in terms of dehumanisation and loss of human dignity. Important but rather intangible things might be lost, it is suggested, in the quest for cognitively improved humans. Some imply that, although cleverer, future individuals would be lesser human beings as aspects of human nature would have been eradicated. Others see cognitive enhancement as ultimately producing more than just improved selves but a different kind of people (super-humans or what some term "posthumans") whose intellectual abilities would make them hostile to ordinary people. In this document, however, we restrict ourselves to the discussion of enhancements within normal species functioning. That is to say enhancements to individuals within the parameters expected of human beings. While recognising that the concept of "normal" cognition covers a very wide range of abilities, we do not attempt to explore the category of enhancements beyond normal species functioning to develop "super-human" intellects.

### What might be lost? Human dignity?

Predictions about damage to human dignity and human nature try to articulate consequences which are often speculative, complicated, vague and hard to pin down. That is not the same as saying they can be dismissed. Kass is a leading proponent of the theory that "our views of the meaning of our humanity have been so transformed by the scientific-technological approach to the world and to life that we are in danger of forgetting what we have to lose, humanly speaking".[93] He reminds us of the basic ethical obligation to do no harm but criticises the narrowness of the definition of "harm" which appears to exclude "the possibility of willing dehumanization".[94] But what precisely does this harmful dehumanization entail? According to Kass, something important is lost when drugs change how humans function by divorcing their performance from effort. Tampering with brain functions, he argues, would disturb people's fundamental ways of encountering the world and threaten not only human dignity but also "the ways of doing and feeling and being in the world that make human life rich deep and fulfilling".[95] He acknowledges that others do not see technology as dehumanizing but rather as the "expression of our highest humanity – of our curiosity and courage, our cleverness and dexterity, our energy and industry, our rationality and perfectibility".[96] His answer is that man cannot live by rationality alone. He argues that science and technology have become divorced from life as it is lived and cannot deal with the human life and soul which are "irreducibly mysterious".[97] Terms such as dignity and personhood are also used to capture the notion that humans are moral agents, rather than just a collection of chemical reactions, which might be implied by the debate about pharmaceutical enhancers.

Human dignity is seen by critics of cognitive enhancement to be at risk although they also admit that dignity is an elusive concept which many people see as having only symbolic value. Fukuyama acknowledges that harms to human dignity are often intangible but says they may accompany practical harms which are "having to do either with economic costs or with clearly identifiable costs to physical well-being."[98] He appears to consider that the advances in biotechnology may lead to unanticipated economic harms for society as well as to unwelcome risks and side-effects for individuals. Some people, however, believe that human dignity is not compromised but enhanced by the ability to exercise greater control over our cognitive abilities, albeit by artificial means.

### What might be lost? Human nature?

Some critics fear that fundamental aspects of "human nature" would be altered by cognitive enhancement and see "unnatural" or artificially engineered methods of improving people as incompatible with it. Kass says that human dignity reflects "the worthiness of embodied human life, our natural desires and passions, our natural origins and attachments, our sentiments and aversions, our loves and longings". He argues that human dignity is a fusion of several attributes, including reason but also "the dignity we have through our loves and longings – central aspects of human life understood as a grown togetherness of body and soul".[99] On the other hand, is it necessarily the case that improving facets such as memory and concentration would really make us different people who are alienated from important values, or just the same people with better memories? Also when we consider "human nature", it is clear that it has cruel and brutal facets as well as benign and compassionate aspects. Civilisation has developed rules and structures precisely to quash some entirely natural facets of human behaviour. Therefore it might seem a dubious argument to reject cognitive enhancement solely because it seems "unnatural" or affecting human nature. We might also question whether there is even such a thing as "human nature" or we may consider that attempting to improve it is not ethically

problematic. Such a view starts from the premise that there is no sanctity about what is called "human nature" which would morally prevent us trying to make it better.

### What might be lost? Deference for nature?

It is clear that some people perceive a serious conflict between what is achieved by natural means and that which might be called "artificial". This is discussed later when we consider if different methods of cognitive enhancement raise different moral issues. A worry for some critics is that humanity might become too separated from the natural world by "playing god". Attempting to improve cognitive functioning by new technologies is seen as an example of human arrogance and hubris. For such commentators, human dignity is associated with the aspiration for a better life but also with acceptance of the limitations and finite nature of human life. On the other hand, humanity's scientific goals throughout the ages have always been to modify or defeat the normal effects of nature, including preventing pestilence, floods and famines. Medicine, by its very nature, is designed to thwart the natural order and this is potentially problematic for some critics of cognitive enhancement who would like to reject some but not all medical advances. Medical technology is seen by some of them as acceptable as an aid to nature's powers of self-healing but they consider it should not overstep that role or be seen as the answer to everything.

### What might be lost? Human diversity?

One of the risks identified by Kass is a kind of homogeneity, diminution of individuality and consequent blurring of personal identity. Harris acknowledges some kind of increased homogeneity is a possibility but not necessarily a worrying one, in the same way that the spread of education and literacy inevitably changes people and society. He agrees that it is conceivable that the "conferral of new powers, of memory, concentration, strength, endurance, or intelligence will lead to a greater uniformity in the sense that people will possibly, albeit over a very long term, differ less drastically in respects amenable to enhancement".[100] They would, however, continue to differ in other ways and, if only some people choose cognitive enhancement, differences within society will increase rather than diminish. Harris also points out that, depending how methods of enhancement work, they might increase the existing differences among people who use them since the technology may simply augment individuals' existing abilities.

Some critics of cognitive enhancements draw analogies between the use of cognitive enhancement techniques and Huxley's *Brave New World* which shows a debased form of human life, lacking dignity and meaning. There, the successful attainment of apparent well-being and an easy life through biotechnology "comes at the heavy price of homogenisation, mediocrity, trivial pursuits, shallow attachments, debased tastes, spurious contentment and souls without loves or longings."[101] This leads some people to infer that some kind of undesirable levelling out and blandness would inevitably occur in society if cognitive enhancements were widely adopted. Some failures, errors and miscalculations contribute to the way people experience the world and learn from their mistakes. Some ingredients of humanity might be lost if individuals were improved by means other than by experience, purposeful effort and hard work. Turner and Sahakian contradict the notion that a homogeneous society, devoid of diversity would emerge. "For this to happen we would have to attend to all facets of human psyche. Some people will always work harder, whether enhanced or not. These technologies are neither so advanced, nor so predictable, that we are in danger of an Orwellian existence."[102]

### Would concepts of personhood be compromised?

Ideas of personhood are linked to an awareness of the world and ability to interact with it. The exercise of autonomy, often seen as a facet of personal dignity and personhood, is not a helpful concept for opponents of cognitive enhancement since individuals may willingly seek the measures which are labelled as dehumanising. Indeed, one of the perceived dangers for society as a whole is that, as a result of autonomy being so respected in libertarian cultures, any risks for the community arising from people selfishly pursuing their own interests tend to be underestimated. There could, however, also be benefits to society as a result of individual enhancement if, for example, that led to greater tolerance. It has been pointed out that enhancements are not worth that name unless they improve what are seen as aspects of personhood and make us "better at experiencing the world through all of our senses, better at assimilating and processing what we experience, better at remembering and understanding things, stronger, more competent, more of everything we want to be".[103] Whether cognitive enhancements can indeed achieve these things and be worthy of the term without sacrificing other values is one of the major questions arising throughout this document.

### Personal identity

Efforts to enhance brain function are more ethically complex than changing one's physical appearance because to some extent we define ourselves as individuals by our personality and intellect. There is something startling and potentially worrying about interventions designed to alter the healthy brain which controls such facets of personality, individuality

and our sense of self. If we tamper with it, is there a risk we may lose our sense of who we are and, if so, does that matter? Critics say it does and find the concept of drugs that change people's personalities repugnant but it is sometimes unclear why. Various reasons suggest themselves, some of which are discussed elsewhere in the document. For example, we may worry about the abuse of potentially personality-changing products, or addiction to them or the fact that people might be coerced to use them against their will. It might be that we do not think personality should change although that can happen naturally as a result of age, accidents, traumas, emotional experiences or losses. It is a cliché, for example, how people's personalities can change and soften when they fall in love or become more anxious when they become parents or suffer bereavement. Individuals' sense of personal identity changes naturally over a lifespan and we can seem, even to ourselves, to have different facets of our persona dominant at different episodes of life. One of the things that friends sometimes find difficult to accept is the way an individual's personality and characteristics change as part of the process of experience and normal ageing. So is our disquiet with cognitive enhancement due to the speed, the artificiality or the risk of unforeseen side-effects that might arise from the use of enhancement technologies?

Supporters of cognitive enhancement point to the fact that since such improvement is one of the main aims of education, achieving the same aim by means of drugs or genetic technology should be seen as equally acceptable. If individual personality and aspects of personal identity can be altered and improved through experience of the world, study, exposure to different cultures and civilisations, then is it unacceptable that similar effects are caused by biotechnology? Aspiring constantly to improve or re-invent ourselves and provide a better world for our children are among the enduring facets of each generation. Our desire to improve ourselves is one aspect of our shared humanity. Is the use of artificial cognitive enhancement simply a distinction without a moral difference? According to Harris, "what matters surely is the ethics of altering our nature, not the means that we adopt. If it's right to alter our nature, we should choose the best and most reliable, not to mention the most efficient and economical, methods of so doing."[104] On the other hand, we do not necessarily accept that the end justifies the means and among the reasons we value education is that it aims to make us all-round better and more reflective people. It not only seeks to stimulate intellectual skills but also to instil a sense of values and awareness of culture. Some fear that the contributions made to a person's identity through the effort of learning would be lost if pills could provide the same level of ability. The point is also often made that greater intellectual powers do not necessarily bring greater happiness or better social functioning for the individual. Indeed, if such powers are produced through techniques whose side-effects are not fully understood, the reverse could occur, leaving people clever but depressed.

## Do different methods of enhancement raise different moral issues?

In the introduction we made the point that it may be entirely reasonable to desire the outcome of an increase in cognitive ability but to reject some methods of achieving that aim. For example, we may support external methods, such as improvements in the provision of education and widespread availability of learning resources, but have concerns about the type of internal cognitive enhancement technologies discussed in this paper. Equally, we may find some of these technologies acceptable and others not. This section explores some of the reasons why it might be legitimate to distinguish between the different technologies suggested.

### Balance of risks and benefits

One of the grounds on which it might be appropriate to differentiate between different methods of enhancements is the balance of risks and benefits. Some techniques will inevitably be more risky, and some are more likely to succeed, than others. For example, at the current time pharmaceutical enhancements are considered the most likely method of achieving a reasonable level of increase in some forms of cognitive ability, in a reasonably safe manner. Brain manipulation and stimulation – were it to prove successful at improving memory or concentration – will inevitably carry risks but whether these are considered so high that competent individuals cannot consent to them is unclear, given other risks that individuals are allowed to take, for cosmetic enhancements for example.

Genetic manipulation of embryos to enhance particular characteristics in future generations, however, is far more speculative and there is serious doubt as to whether this will ever be technically possible. This is principally because of the very large number of genes that are likely to have an impact on aspects of cognitive ability, the very small effect of each of these genes and the fact that it is impossible to determine what any incidental, adverse effects might be. Even if it were possible, there are safety issues that are likely to rule it out as a practical option. At least at present, the safety and efficacy of this type of germ-cell modification is likely to remain elusive and the level of benefit that could be derived from such non-medical interventions is unlikely to be considered sufficiently important to offset the inherent, unavoidable and unknown risk to future generations.

### "Natural" versus "unnatural" methods

It is interesting that, as a society, we seem to have no problem at all with people taking all kinds of nutritional supplements and herbal medicines but, unless there is a medical justification, we have concerns about the use of "pharmaceutical products", many of which are themselves derived from plants. A superficial, but frequently used, justification for that apparent distinction is that the former is "natural" whereas the latter is "unnatural" – implying that there is not only a practical but also an ethical difference between the two. It is important to challenge such assumptions. It is not the case that we generally see things that are "unnatural" as bad; many procedures, products and techniques that we use and readily accept are not "natural". In fact, medicine itself is not natural but we do not reject it on that basis. We mentioned in the introduction the initial negative reaction to technologies such as heart transplantation and IVF, which were considered "unnatural" but are now accepted and welcome additions to the armament of procedures that can prolong and improve life. As discussed previously some philosophers have argued for a difference between natural and unnatural methods of enhancement as part of a defence of our humanity and human nature but others have rejected that distinction. If we want to rely on that difference in our assessment of cognitive enhancement, we need to be prepared to justify it, either by a clear rejection of all unnatural means of achieving our aims or by explaining why, with cognitive enhancements in particular, the use of what we see as natural methods are acceptable whereas those we perceive to be unnatural are not.

A distinction might be made between these broad categories on the basis of risks and side-effects. The fact that nutritional supplements are purchased directly from health food shops, without the need for a prescription, may provide reassurance about the safety of those products. In contrast, the fact that a prescription is needed for pharmaceutical products implies that some form of monitoring is required raising concerns about their safety. In fact, although people may perceive natural products to be safer, this is not always the case. Some natural and herbal remedies can also be harmful and in fact the Medicines and Healthcare Products Regulatory Agency (MHRA) has part of its website dedicated to the risks of herbal medicines and possible interactions between products. If this is the basis for the distinction, however, the justification is one around the relative safety of the procedures and not on the basis of whether the method is natural or unnatural.

There may also be an extent to which people see nutritional products as relatively benign, having neither harmful nor beneficial effects. As such we do not need to worry about the impact of their use and if people want to spend their money on them, there is no reason to prevent them from doing so. There is a certain irony to the fact that we do not object to methods that are considered ineffective but as soon as scientific progress provides something that actually works, we begin to have concerns. This observation has also been made in connection with methods people use to try to influence the sex of their children.[105]

### The involvement of health professionals

With the exception of nutritional supplements, the methods suggested in this paper would currently all involve some form of medical intervention. Pharmaceutical products usually, but not always, require a prescription from a doctor, although later in this paper we consider whether this is necessarily appropriate where their aim is enhancement and not curative. Brain stimulation and manipulation and genetic selection or enhancement would always require the involvement of health professionals. This raises questions about the purpose of medicine and whether it is appropriate for doctors to be involved in providing what is essentially a life-style choice (although to some degree this already occurs) and a search for individual positional benefit. Can, or should, a legitimate distinction be made on the basis of whether or not medical involvement is required?

The aim of medicine has traditionally been seen as curing the sick and bringing the level of functioning back to the norm, however that is defined. But increasingly, health care is much broader than this and perceptions of "clinical need" have changed over time. Doctors have an explicit, and important, role in maintaining public health, with interventions aimed at preventing the healthy from becoming ill as well curing those who have already succumbed. Helping people to give up smoking or excessive drinking or to lose weight and the use of immunisation are all common interventions aimed at healthy individuals with a view to avoiding illness. Modern-day health care also includes some interventions where the aim is more explicitly to improve aspects of quality of life. It is not unusual for doctors to prescribe what might be considered "life-style" drugs, in the sense that they are not necessary to correct essential functioning but promote human flourishing and improve the patient's quality of life. This includes products such as oral contraception, hair-loss treatments and medication to overcome erectile dysfunction. Doctors will sometimes prescribe drugs to help people to overcome shyness or lack of sleep at times of excessive pressure or demand; how much different would it be for doctors to prescribe medication, or to carry out medical interventions, that could aid concentration or to improve memory where lack of those skills may have a detrimental effect on the individual's future prospects or quality of life? Chatterjee asks just this question: "if improving quality of life is an explicit goal for physicians, and quality of life does not always correspond directly with clinical-pathologic indices, then why not consider biologic interventions for the quality of

individuals' lives whether or not they have a disease?"[106] Fukuyama takes the opposite view arguing that "the original purpose of medicine is, after all, to heal the sick, not to turn healthy people into gods".[107]

Given that medicine is no longer purely concerned with healing the sick (if it ever was), we need to consider whether the provision and monitoring of cognitive enhancements is an appropriate role for health professionals. There are two elements to this: first, what is an appropriate role for a national health service? Is it simply to cure the sick? Should it also include measures to improve the public's health and thus prevent sickness? Or should it go further and also include broader notions of social welfare and improving quality of life among its aims? The use of cognitive enhancements by people who are not sick would fall into the latter category and it may well be judged that this is not an appropriate role, or at least is not a priority, for NHS funding. The second question then, is whether it should be provided by doctors at all. Some other procedures undertaken by health professionals are not considered appropriate for NHS funding but are nevertheless considered appropriate for health professionals to perform because of the knowledge and skills required. Cosmetic surgery is one such example – much of this is on a private basis given that it is not essential to health or part of the core services that should be provided by the state, but doctors are still involved. Are these types of procedures, where the perceived advantage is purely social rather than health related, appropriate uses of medical knowledge and training?

Where health professionals are to be involved, we also need to consider what, if any, responsibilities they have for their actions. The BMA has always argued that where health professionals are involved, on a professional level, to help someone to have a child, they have some moral responsibility to ensure that the child is not at foreseeable risk of serious harm. In other words, they have some moral obligation to consider the consequences of their actions. As already mentioned, many surgical, medical or pharmaceutical interventions involve or risk harm to the patient but these harms are offset by the benefits that accrue from curing or alleviating the symptoms of disease. The use of drugs, or brain stimulation, for enhancement also risks harm to the individual but the benefits may be less tangible. Is this just an issue for the patient or do doctors also share some responsibility for the consequences of agreeing to provide this technology for healthy people?

### Temporary versus permanent methods of enhancement

Another distinction that might be made is between temporary and permanent methods of enhancement. Some of the methods discussed in this paper, such as the use of nutritional or pharmaceutical products and brain stimulation or manipulation involve temporary measures that do not seek to make permanent changes to the brain. Genetic interventions, however, are both permanent and irreversible. Do the arguments of the likes of Kass and Fukuyama about the essence of our humanity, discussed above, have more resonance where we are seeking to make changes that will affect our abilities and, to an extent, our nature forever? Or, if these are positive changes and an improvement to our natural functioning, are there not good arguments for making them permanent rather than needing to constantly repeat the intervention? This would allow us to be permanently enhanced rather than choosing particular tasks or times of our lives when such improvements would be particularly beneficial. Should we not use the most effective and efficient method for achieving what we consider to be a positive end?[108]

### Individual versus proxy decisions

Another way in which genetic interventions differ from other methods of enhancement is the locus of decision-making. We may consider there to be a difference between cases where competent adults decide to enhance themselves and where parents make decisions on behalf of their children. Or we may see a fundamental difference with genetic selection or manipulation of the germ line, which inevitably involves making decisions about and on behalf of future generations. These issues are discussed in the more detail in the next section.

## PART FOUR – HOW SHOULD SOCIETY RESPOND?

### Should there be limits on choice?

#### The public good and competent adults choosing for themselves

A widely accepted precept is that personal liberty is in the public interest as well as being empowering to individuals. Competent and informed individuals should generally be able to choose how they manage their own lives as long as their activities do not impinge in a harmful way on other people. In this view, the goodness or badness of individuals' choices should not necessarily be a concern for other people unless others are themselves pejoratively affected. Far from harming others, supporters of cognitive enhancement would argue that society as a whole stands to benefit by individuals voluntarily choosing it and raising intellectual standards. Indeed, they might go even further and argue that not only do we have the liberty to choose such enhancement but we have moral obligations to improve society in this way if it lies within our power to do so at no cost to ourselves or to others. Opponents, however, might see such changes as having high costs in the form of undesirable consequences, including the risks of side-effects for those who choose the enhancing technologies and coercion or career disadvantages for those who do not. Would those arguments be strong enough to limit informed individuals' access to those technologies for themselves?

Starting from the principle that the limits imposed by society on personal choices should be justifiable, where we suspect that a particular choice will affect others pejoratively, some empirical evidence of harm is normally required. Drivers are not free to choose how fast they go or whether they wear seat belts because data show that accident rates and costs to society rise in the absence of such regulation. The effects of some practices, however, are not amenable to that kind of analysis. Although constraints can also be imposed if the choice is seen as having a more abstract impact on society or its values, if the effects are abstract, they are impossible to measure. Thus, while there is no doubt that society can and should impose limits on what competent adults can choose for themselves if the consequences for society would be unpalatable, cognitive enhancement is problematic because views vary significantly about whether any harm – practical, moral or psychological - would result. The kinds of objections raised by critics of cognitive enhancement tend to be more concerned with its perceived unnaturalness or its threat to human dignity, rather than with harms that are open to empirical, evidence-based verification. Therefore, evidence either way is unlikely to be forthcoming and ethical analysis of enhancement technology becomes complicated when applied to lifestyle choices. Some suggest that, in the absence of evidence or where the claims of harm are not open to scientific analysis involving empirical evidence, it may be wise to restrict the practice, simply as a precaution.

#### The Precautionary principle

The "precautionary principle" or "precautionary approach" is one method of dealing with uncertainty in the face of possible risks. It is based on the notion that we should avoid any action that could result in serious or irreversible harm to the public, people's health or the environment, even though there is no evidence to help us assess the likelihood or magnitude of such harm. It is a principle that comes into play when there is no scientific consensus about whether a proposed course of action would be hazardous and it puts the burden of proof on those who support taking the action. Given the above-mentioned problems of assessing the impact of cognitive enhancement, supporters have a difficult task in providing such proof. The principle gains most weight in situations where the effects of the proposed action are likely to be irreversible which would apply to some, but not all, of the forms of cognitive enhancement discussed in this paper. If the precautionary principle were to be applied here, cognitive enhancement would only be widely permitted when proven safe for individuals and non-threatening to societal values but evidence could only be gained by allowing and observing its use.

Harris points out that when there is no evidence of harm and we cannot tell in advance whether a change or the status quo would be most beneficial for humanity, it is unclear why we should give preference to leaving things as they are. "In the absence of reliable predictive knowledge as to how dangerous leaving things alone may prove, we have no rational basis for a precautionary approach which prioritizes the status quo".[109] He quotes Cornford's argument that if we always prefer the status quo, "it follows that nothing should ever be done for the first time".[110]

#### Should we limit what people can choose for others?

Morality can be defined as an acknowledgement of what we owe to each other.[111] We might be thought to owe it to others to improve the intellectual fabric of society, by cognitive enhancement, if shown to be safe. By our own actions and choices, we might also indirectly impact on those available to other people which can be seen as a way of choosing for others. So, for example, if the majority of us choose to use some methods of cognitive enhancement, we make it harder – but not impossible – for other people to opt out of doing so. This is discussed in the section on pressure and coercion.

Among the things we owe to those around us is to play a part in ensuring that society is decent and caring, both by our own actions and by the way we raise the next generation. Children are the main group on whose behalf proxy decisions about cognitive enhancement are likely to be made but a focus only on intelligence and cognition may not necessarily make them the caring individuals we would like them to be. Choosing for other people is a fraught concept, especially if the choice is being made on behalf of someone as vulnerable or powerless as a child. Yet very important decisions are made all the time by parents who are generally seen as in the best position to decide matters for their offspring until the latter are capable of deciding for themselves. Parents, however, are only allowed to choose what would be in the "best interests" of their children and differences of opinion often arise as to how that is defined. Like all citizens, they should also consider the effects on society of their behaviour and choices. Therefore, they should not deliberately raise their children to be aggressive or bullying, for example, even if they consider that to be in the child's interests in a competitive society. Ultimately the wider community, through agencies such as the judicial system, decides how far parental choice extends and parents' rights are curtailed if, in the view of the courts, they appear to be choosing something bad for their child even if they genuinely believe it to be beneficial. But this needs some sort of societal consensus about what is harmful and such consensus about cognitive enhancements is clearly absent.

### The right not to choose for others

One potential cause for concern is that parents or other people might be pressured to make choices for children that they would prefer not to make. Most parents aspire to providing a happy existence for their children and some may fear that emphasising intelligence alone might result in children suffering emotional or psychological problems. Clearly, it is important that individuals should not be obliged to choose options for other people that they consider wrong. It is generally accepted that, when we have to make choices on behalf of other people, the benchmark should be whether our intervention is likely to impair or enhance their own future freedom to choose. We should not, on the whole, make choices for them which limit their freedom but it is seen as permissible to provide the means of extending the range of choices they could make.

### The risk of commodification

One of the arguments in favour of restricting people's freedom to choose cognitive enhancement for themselves or for others concerns whether we want to have a society in which human intelligence is another commodity, so that people come to see their bodies as mechanisms to be improved, even when they function normally. There is an anxiety that something essentially human and individual would be lost through the use of cognitive enhancements and that this could result in a form of homogeneity and conformity that would not ultimately be in the common good. Some of these arguments are discussed in the section on humanity and identity. The question arises, however, as to why we apparently tolerate other measures, such as cosmetic surgery which also appear to commodify and homogenise humans according to a fashionable norm, regardless of their natural size and shape.

If there is a risk of commodification when informed adults choose cognitive enhancement for themselves and regard their faculties as tools to be honed, then that risk seems even greater when they are choosing the make-up of their future children. It is often suggested that parents' desire to design facets of their children's lives or bodies represents an unacceptable form of commodification and a reluctance to accept them as they are naturally. This has been a long running debate in relation to the concept of "designer babies" and some of the same arguments used for and against parental choice in that context can be applied to cognitive enhancement. For example, it is argued that selecting or enhancing non-medical characteristics in future children has a fundamental effect on the way we perceive children. It has been seen as a challenge to the unconditional love that children deserve, making our acceptance of them conditional upon their particular characteristics – in the case of cognitive enhancement, their future intellectual abilities. In our market-led society, choice is seen as positive but should the production of human beings be subject to the same supply and demand principles of the market? Does this not undermine the intrinsic value of human beings as they *are* rather than how we would design them to be?

Such arguments are rejected by Glover[112] and other commentators such as McLean[113] who argue strongly in favour of reproductive liberty. In their view, it is the right of parents alone to make decisions about their future offspring unless the decisions they make would clearly be harmful. They argue that for any legitimate restrictions to be imposed by the state on individual's reproductive decisions there must be clear evidence of harm rather than only untested and unproven speculation.

### Parents' procreative liberty and children's rights

One of the reasons we have reservations about parents making some potentially life-changing decisions for children is because the people who are affected cannot give consent to the intervention. This is, of course, true of many - if not most - proxy decisions and it is part of the responsibility of parenthood to decide what is in the best interests of young

children, precisely because they cannot give consent themselves. Parents also make decisions affecting children not yet born and deciding what would be in their best interests can be more challenging. Issues such as parents' choices about how many offspring to have and when will influence their future children but are seen as innocuous. Procreative liberty which includes fundamental choices about whether or not to have children at all is seen by some people as "central to personal identity, to dignity, and to the meaning of one's life".[114] Glover points out, however, that before reproductive technology made a range of choices available to prospective parents, not being able to specify the kind of child one wanted or its gender were not seen as demeaning to parents' dignity or lessening their sense of personal identity. [115] Nevertheless, once choices become available, questions inevitably arise about who should make them and on what criteria.

Much of the ethical debate about procreative rights and inter-generational justice has stemmed from instances in which potential parents have choices which may avoid the birth of a child with disabilities. That is to say that much discussion about pre-birth parental choice is not about enhancing normality but rather attempting to avoid facets seen as disadvantageous to the future child. When parents decide to use preimplantation genetic diagnosis to avoid a serious genetic disorder, that is a decision that affects the future child albeit in a way that is generally considered to reflect the child's interests. Such decisions are more controversial, however, where the selection is on the basis of non-medical characteristics. If it were possible for parents to select from amongst a number of embryos created for IVF, those that had the highest capacity for intellectual development, we might consider that this would be in the best interests of the child since it gives that child the best chance of a successful future; something we surely all want for our children. But by imposing our own designs, is it also denying that child an open future and the opportunity to make his or her own decisions? Habermas believes so, arguing that: "eugenic interventions aiming at enhancement reduce ethical freedom insofar as they tie down the person concerned to rejected, but irreversible interventions of third parties, barring him from the spontaneous self-perception of being the undivided author of his own life".[116] Once such decisions are reflected in our genes, we have no way of rejecting them. This has been referred to as genetic despotism of one generation over the next[117]. It needs to be acknowledged however that "we are all in the position of having had "the way we are" determined by a combination of the acts and omissions of our parents and others with whom we have interacted since conception"[118] and so our ability entirely to control our own life and personality is inevitability limited.

### Procreative perfectionism

Glover points out that "the new possibilities of genetic choice have encouraged what could be called procreative perfectionism: the view that we should aim to have children who will have the best chance of a good human life".[119] He questions whether there are constraints on individual's procreative liberty in terms of what people owe to their children and whether there is a "moral obligation to choose children with maximum potential for human flourishing".[120] He concludes that most people probably do not think that there is such an obligation. Other commentators have argued that there may well be such an obligation. Savulescu, for example, says that potential parents "should select the child, of the possible children they could have, who is expected to have the best life".[121] This argument, that parents have a moral obligation to select the best children they could have or those with the characteristics most likely to succeed in society, is seen by some as switching humanity from the path of natural selection to one of "deliberate selection" with overtones of intolerance or rejection of any people who do not meet the required standard in terms of appearance or ability. Even if it were to be accepted that parents should strive to have a child with the best life, there are various problems, as Parker points out, to implementing that notion in practice. It would require parents to be "capable of ranking possible lives as better or worse".[122] Attempting to define "a good life" for another person is so fraught with difficulty as to be virtually impossible. Parker questions, for example, whether "a life free of troubled interpersonal relationships, free of suffering, loneliness or misunderstanding is a better life, or even, taken as a whole, a happier life, than one in which experience of these to at least some degree has played a part?" He points out that "human lives are by their very nature characterised by both good and ill" and the determinants of a good life are "as much to do with the broader social, political, economic and environmental contexts in which people live as they are to do with their biological make-up".

### Should parents alone decide for children?

As already discussed, parents alone are generally judged to be the best people to choose for their children, but this may not be the case if there is insufficient information available to judge the long term effects of any elective procedure. Parents are not empowered to make choices if there is risk or doubt about the intervention and few would wish to do that. It is widely accepted that children should not be exposed to innovative procedures unless they have been proven safe and effective in consenting adults. Even then, there could be more or different risks to using enhancements in children whose brains are still developing. Children cannot use them until their long-term safety is proven in children but that creates a conundrum as they cannot be proven safe in children unless healthy children use them. Turner and Sahakian point to the uncertainty of what is at stake and which might encourage us to apply the precautionary principle,

at least for children. "It would be devastating to learn that a dazzling youth of successful cognitive enhancement meant a middle age of premature memory loss and cognitive decline".[123] These types of concern alone may lead us to question the ability of parents to make truly informed decisions about the use of cognitive enhancement for their existing or future children.

## Is there a need for regulation?

In the same way that there are different views about the acceptability, harms and benefits of cognitive enhancements, so there are mixed views about the need for, and desirability of, regulation in this area. Some have argued strongly against regulation on grounds of "cognitive liberty", that: "the individual, not corporate or government interests, should have sole jurisdiction over the control and/or modulation of his or her brain states and mental processes."[124] Others have argued that the "obvious" answer is that "we should use the power of the state to regulate it".[125] There are two issues, however, on which there seems to be little disagreement. The first of these is that the development and use of some forms of cognitive enhancements are inevitable; the second is that now is the time to begin to consider this issue and to decide, as a society, how we should proceed.

There are a range of regulatory options that could be considered incorporating aspects of prohibition, permissive regulation or a laissez-faire, free market, approach. We could, for example:

- prohibit the use of cognitive enhancements in healthy individuals, with penalties either for their supply or use (as with recreational drugs and techniques such as reproductive cloning);
- permit some methods of enhancement (such as the use of nutritional supplements and pharmaceutical products) and prohibit others (such as genetic selection and manipulation);
- permit the use of enhancements in some situations or for some patients but not others (for example, in explicit competitive situations their use could be prohibited or their use could be restricted to adults who are able to give consent);
- have a permissive system of regulation – as with assisted reproduction – where techniques are permitted under licence from a regulatory body;
- rely on health professionals to act as "gate-keepers" of such technology subject to guidance from professional and regulatory bodies; or
- allow individuals to make their own decisions and leave the area completely unregulated or regulate only the claims made about the products or techniques to ensure individuals are not misled.

These options are not mutually exclusive and could be used in combination. For example, we could allow informed individuals to make their own decisions about taking nutritional or pharmaceutical products for enhancement, except in competitive situations where their use would be banned. Access to brain stimulation and manipulation could be controlled by health professionals and the use of genetic selection subject to a licence from the Human Fertilisation and Embryology Authority which regulates other forms of selection using preimplantation genetic diagnosis. Genetic modification could be prohibited by legislation.

Whatever system we opt for, however, should be a positive choice not the result of apathy or because we have not given due consideration to the issues. This is principally a matter for government but it raises issues that are important to us all and therefore some societal debate is required. There are two key questions we need to consider: is there a need for regulation? And, if so, what form of regulation would be appropriate?

### The purpose of regulation

The main purpose of state regulation is to protect individuals and society both directly and indirectly. Regulation can also help to develop confidence in new technology through the knowledge that it is being monitored and is subject to controls to prevent misuse. The medical profession and medical procedures and treatments are already subject to generic regulation through a combination of statute law and regulatory bodies, such as the General Medical Council, the Medicines and Healthcare products Regulatory Agency and the Healthcare Commission. In some areas of medical practice, including the development of new technologies or new uses of technologies, this is considered sufficient; in others, particular areas are singled out for additional regulation. Assisted reproduction is the most obvious example where certain procedures may only lawfully be undertaken with a licence from the statutory body (the Human Fertilisation and Embryology Authority). This area was selected for regulation in order to protect the interests of those seeking treatment and of society by ensuring that there were controls on the use of new technology. It was also considered that many of the issues went beyond the individuals directly involved and raised important societal issues, such that there was a need to ensure that certain ethical boundaries were not crossed. Legislating also served to promote public confidence in this area of practice so that society could reap the benefits of the technology whilst

protecting against potential harms. Other areas that are also seen as controversial and raising broad social issues, however, have not been chosen for statutory regulation. The use of genetic information and technology, for example, is subject to guidance and voluntary self-regulation but there is limited statute law in this area.

Decisions about which activities or developments need to be regulated by statute, which can rely on guidance and self-regulation and which should be left to individual choice are made by Parliament. In practice, such decisions rest on a range of factors including an assessment of the risks and benefits, the extent to which decisions made by one party affect others, the interests (including commercial interests) at stake, the potential and risks of misuse and the views of society about the acceptability of the proposed activity.

Regulation by the state is not the only form that regulation can take. There are also rules that govern particular activities or establishments which may be relevant to cognitive enhancements. For example, in situations that are explicitly competitive, such as entrance examinations to Oxford or Cambridge Universities, the relevant examination boards may wish to prohibit the use of cognitive enhancements in order that they can assess the natural ability of the candidates, rather than their desire and ability to obtain methods of enhancement.

## What form should regulation take?

In a document of this nature it is not possible to consider, in detail, the full range of regulatory options and the relative merits of each. Instead, this section aims to highlight some key issues in relation to each broad regulatory approach, both to give an indication of the complexity of the issue and to begin to explore some possible options.

### *Prohibition*

One position that society could adopt is that the use of some or all forms of cognitive enhancement by healthy people is unacceptable and that such activities should be prohibited by law. If we adopt this position, thereby restricting personal autonomy, we need to be able to justify that action by showing why failure to do so would cause harm or, in the absence of actual evidence of harm, that there is an unacceptable level of risk. The fact that many people do not agree with enhancement is not, in itself, sufficient justification to prevent its use by those who take an opposing view.

The first challenge, having made such a decision, would be to draft legislation in a way that is clear and concise. Given the difficulty with defining what we mean by "enhancement" (as discussed in Part One of this paper) and the added complication of deciding who is "healthy", this is by no means an easy task. A second issue is how to ensure that people comply with the legislation and Brownsword argues that regulators might use one of three strategies to encourage compliance: moral, practical or behavioural.[126] If there is widespread support for the prohibition, it may be possible to appeal to moral reasoning – if people agree that the use of cognitive enhancement is wrong they are more likely to support and comply with the legislation. If, however, the prohibition does not gain widespread support, and many people do not agree with the moral underpinning of the legislation, this tactic cannot be relied upon. It might be possible then to rely on practical arguments: to make people see that there are good reasons to follow it (this usually relies on self-interest arguments, often economic interests). The third, behavioural, strategy does not rely on moral or practical arguments to encourage people to conform but simply engages with those who will be subject to regulation to the extent and in the way that is necessary to ensure that the desired pattern of behaviour is achieved. This is often by way of a "technical fix". If it were possible, for example, to neutralise the enhancing effects in those whose cognition was within the normal range, so that the technology simply would not work, this would be a behavioural strategy for ensuring compliance with legislation prohibiting the use of cognitive enhancements in that group of people. In practice, however, such a technical fix is unlikely to be available in this area.

We also need to consider the implications of prohibition including acknowledgement of the fact that because something is prohibited in law in the UK, this does not mean that it will not be available. Many drugs are available over the Internet and such provision is very difficult to regulate.[127] UK-based companies can be prevented from marketing and selling drugs in this way but International regulation would be required in order to impose our restrictions on companies operating overseas. Similarly, it is increasingly common for patients to travel to other parts of the world for treatments that are not available at home (so called "medical tourism"). There are two major implications of this that need to be considered. The first is that cognitive enhancements, purchased from overseas, will only be available to those who have the means and resources to access them. This is likely to further increase the disparity of access that was raised earlier in the paper as one of the concerns about cognitive enhancements – prohibiting access within the UK, could exacerbate rather than solve the problem of inequity. The second implication of people accessing such drugs or procedures clandestinely is that there can be no effective monitoring or control of their use. People could experience serious complications, or even die, after taking medication obtained without appropriate medical checks. There may, therefore, be an argument that if such procedures or techniques are to be used, it is better for this to be done openly and with controls and safeguards. There is also a risk that if people want procedures or medication that they perceive will benefit them they may be tempted to use subterfuge in order to obtain them: exaggerating or inventing symptoms in order to

obtain them for "therapeutic purposes" when, in fact, their aim is to use them for enhancement. These are always risks when procedures or techniques are prohibited in the UK – and the use of sex selection techniques for social reasons or the use of living donors who are paid for their kidneys are examples where these factors have been considered but nonetheless, on balance, it has been decided that prohibition is the appropriate route for the UK because of broader concerns about those practices.

Although the UK is generally supportive of personal autonomy there are limits to the risks that an individual can willingly consent to take. At the extreme, an individual could not, for example, consent to being a living heart donor, where this would result in the patient's death. One of the reasons why reproductive cloning is prohibited in the UK is because the risks are simply too great and the benefits that are likely to accrue are not sufficient to outweigh the unknown and unknowable risk of serious harm. The same is true of germ-line gene therapy although in both of these cases there are also ethical arguments and societal issues that have been raised to oppose the use of those procedures. If the risks of cognitive enhancement – to the individual and society – are considered to be sufficiently great that they fall into this category, then prohibition may be appropriate. But how much risk is too much? It has been suggested that we could set a baseline level of acceptable risk, perhaps linked to other risks that society allows individuals to take, such as smoking or mountain climbing, and anything that could be shown to be no more risky than these activities would be allowed.[128]

*Permissive regulation*

Another option would be to allow cognitive enhancements but with some form of controls and safeguards. This could take a number of forms, such as the establishment of a new regulatory body to approve the use of particular techniques and to issue guidance for their use – the Regulatory Authority for Cognitive Enhancements (RACE) perhaps? Or, doctors could be asked to act as the "gate-keepers" for such services.

It has been argued that the UK suffers from regulatory overload and that state intervention in individual choices made by patients, in consultation with their doctors, should be kept to an absolute minimum. The establishment of a statutory regulatory body is expensive, bureaucratic and involves considerable work and time from those regulated. This needs to be balanced against the benefits of having such a body to ensure that the response is proportionate and not seen as the easy option to a difficult problem. The establishment of a regulatory body can have benefits but is not the panacea for all new technologies.

Doctors act as gate-keepers to therapeutic treatments and, as discussed earlier, some of these procedures are more related to quality of life issues than to curing or managing the symptoms of disease. But, is it appropriate for doctors to be involved in procedures that are used, and designed to be used, for the explicit purpose of enhancement of healthy people? In addition to adding to the already over-burdened workload of general practitioners and other health professionals, it is highly questionable whether this is an appropriate role for doctors. It is not clear why they would be in any better position to assess the usefulness or benefit of the procedure than anyone else and, in fact, given the very subjective nature of such benefits, they will definitely be in a worse position to judge benefit than the patient. In practice, therefore, it would be difficult for doctors to turn down requests from patients, except on the basis that they do not personally agree with the use of cognitive enhancements; this would be an ineffective and inappropriate way of deciding who should and who should not have access to the technology. The advantage of doctors being involved is that they are in a good position to understand and explain the risks of the technology but this is a rather different role than acting as "gate-keepers" and making decisions about access.

*Laissez-faire*

We may decide that the use of cognitive enhancements is acceptable and unproblematic and therefore additional regulation is unnecessary. People could then choose what, if any, technologies they wish to make use of and seek them out in the same way they would other life-enhancing treatments or procedures. The area would not be totally unregulated because the procedures would be subject to the same generic regulation as other products or procedures, such as the regulation of pharmaceutical products and devices and the European Directive controlling claims that can be made about nutritional supplements. The General Medical Council could issue guidance for doctors about what would be considered "good medical practice" in this area.

If we decide to follow this route, one issue that would need to be considered is what, if any, role doctors should play in the provision of such treatments. If pharmaceutical products are to be used purely for enhancement, then we need to consider whether it is appropriate for doctors to have a role in facilitating and monitoring their use. The Medicines and Healthcare products Regulatory Agency (MHRA) makes recommendations about which products should be available only with a prescription, which should be available from pharmacies – either with a prescription or over the counter – and which should be available more widely, such as in health food shops. In making such decisions they consider a range of factors. One of the factors is, of course, safety, and there would be appropriate and legitimate concerns about making products available without adequate oversight where there were real concerns about the side-effects.

Of course, some other forms of enhancement discussed in this paper would always require medical involvement. Brain stimulation or manipulation or genetic selection, for example, requires specialist training and expertise. So, perhaps if doctors are to be involved, the answer is to separate this role from their therapeutic role, and to have some doctors who focus exclusively on enhancement technologies, whether that is cosmetic or cognitive enhancement. There is a precedent here, in that cosmetic surgery must be undertaken by qualified surgeons but this is a separate service to the therapeutic, diagnostic and treatment service provided to those who are sick. Botox is another example of a product that is used purely for cosmetic purposes and so is prescribed by doctors working in cosmetic and beauty establishments rather than in the general practice setting. Such a distinction would enable those seeking enhancements to have legitimate and safe access whilst also differentiating between treatments or procedures with a therapeutic aim and those whose only goal is enhancement. Will clinics that specialise in cosmetic surgery then add cognitive enhancement technology to the panoply of services they offer those wishing to pay for procedures that have no therapeutic benefit but which they perceive will provide them with some benefit? It has been suggested for example that some neurologists will become "quality of life consultants" offering a menu of options and providing information about risks and likely outcomes but abrogating final responsibility for decisions to patients.[129] Cosmetic surgery may not, however, be the best model for cognitive enhancements given that concerns have been expressed about the lack of regulation in this area. When giving evidence to a Parliamentary Committee in June 2007, for example, the Chief Medical Office for England, Sir Liam Donaldson, named cosmetic surgery as the one key area of medicine, currently unregulated, that he believed needed to be subject to regulation.[130]

There are other implications of a decision that cognitive enhancements are acceptable and should be, if not exactly encouraged, at least permitted by those who wish to use them. If we believe the use of cognitive enhancements are acceptable, then there is some responsibility on those providing them to ensure that they are safe and effective – or at least that the risks are quantified and participants are given accurate information. This means allowing research involving healthy volunteers, with the specific intention of developing products for enhancement of healthy individuals and having a system of subjecting such techniques to objective assessment in the form of licensing or approval for use. Currently in the UK there is no regulatory framework in place to enable the licensing of drugs aimed specifically at healthy individuals[131] but if, as a society, we embrace cognitive enhancements, this might need to be revised.

## PART FIVE – KEY QUESTIONS FOR DEBATE AND CONSIDERATION

This discussion document has raised a number of issues and questions to help to inform public debate about the acceptability or otherwise of cognitive enhancements and to consider how, as a society, we might respond. There are, however, five key questions that are central to this debate:

1. Should individuals be free to make their own decisions about the use of cognitive enhancements or are there good reasons to prevent them from doing so?

2. Should parents be free to choose cognitive enhancements for their existing or future children or are there good reasons to prevent them from doing so?

3. Should the same principles apply to all forms of cognitive enhancements or are there legitimate grounds to distinguish between methods? If there are good grounds, on what basis should decisions be made about the acceptability or otherwise of particular methods of cognitive enhancement?

4. What role, if any, should doctors play in providing and monitoring cognitive enhancements?

5. What, if any, regulation is needed?

The BMA hopes that this document will encourage other organisations and policy-makers to take forward this debate and to find ways to promote public discussion around these and other relevant questions.

## APPENDIX

### Basic guide to the brain

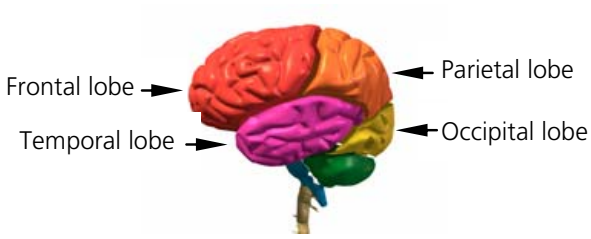
The human brain is a very complicated collection of cells but fortunately it is not essential to have a detailed knowledge of the entire brain and how it works in order to consider the ethical issues which are the focus of this paper. It is useful, however, to have a general idea of some brain functioning in relation to cognition and this simplified explanation aims to provide that.

#### Cerebrum

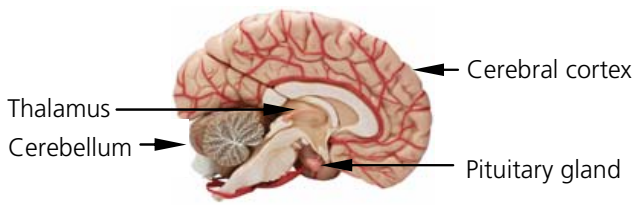
The largest part of the brain is the cerebrum, composed of two hemispheres which are divided into lobes: the frontal, parietal, temporal and occipital lobes. The grey matter on the outer surface of the cerebrum is the cerebral cortex. Each hemisphere controls the opposite side of the body. Each lobe has certain specialised functions but most parts of the brain work together to carry out most processes. The front of the frontal lobes are responsible for the most complex brain functions, such as thinking, conceptualization and planning and their outputs are fed back to the motor areas in the back of the frontal lobe to control movement. The parietal lobes are responsible for orientation in space and time; the temporal lobes deal with analysis of sound and some aspects of visual memory whilst the occipital lobes process visual stimuli. In most people linguistic functions are found mainly in the left hemisphere: the production of speech in the left frontal cortex, the comprehension of speech and print in the left temporoparietal region. So the left is often known as the dominant hemisphere. If damage occurs in one hemisphere of the brain, the other hemisphere can often compensate to some extent by taking over some of the functions previously carried out by the damaged area.

Often, however, brain damage has been considered irreversible and irreparable. Many coma patients, for example, never recover consciousness; nevertheless it appears that parts of the cortex may function even when the patient appears to be unconscious. Consciousness is lost or seriously impaired in patients in coma-like states, such as persistent vegetative state (PVS) or minimally conscious state (MCS). The search for a therapy for MCS has involved deep-brain stimulation. It was found that by stimulating cells in the thalamus (between the brain stem and the hemispheres, relaying information from the eyes, ears and skin to the cortex) it may be possible to trigger into action the undamaged parts of the cortex. This treatment provides clues about how goal-directed information is processed in the brain. Shadlin and Kiani, who published this work, explained that "in essence, the brain does not process information in the abstract but consults information acquired through the senses and in memory insofar as it bears on the decisions made about potential actions and strategies. Our brains allow us to decide among possible options – that is, how and in what context to engage with the world around us."[132] Consciousness itself can be seen as a decision by the brain to engage and allocate attention to what is happening in the environment.

The four lobes of the cerebrum




A cross-section through the human brain




#### Neurons and synapses

The control centres in the cortex are connected by nerve tracts or neurons which communicate sensations and carry an electrical signal from one to another. Around 100 billion neurons are present in the brain; each has up to 100,000 dendrites which are branch-like structures that receive signals from neighbouring cells. A signal arriving this way in the neuron may be either suppressed or amplified by other incoming signals. As the signals converge in the neuron, a new signal is formed which passes out of the cell via the axon which is like a thin wire that connects with the next neuron's dendrites. Each neuron has only one axon but it may terminate in a number of small branches. Neurons are separate entities but the dendrites of each neuron reach out and appear to link up with the axons of adjacent neurons so that before the invention of the electron microscope, scientists believed they were joined up. The tiny gaps between the cells at the apparent point of contact are called synapses. Signals pass from the axon via synapses to connecting cells.

## Neurotransmitters

As signals pass from the axon to neighbouring dendrites, they pass through the small gap called the synapse which is about a 200,000th of a millimetre across. Chemicals secreted by the axon and known as neurotransmitters convey the signal from the axon to receptors embedded in the dendrites of the receiving neurons. The chain effect produces simultaneous activity in millions of cells. The electrical signal arriving along the axon is converted into a chemical signal that carries it across the physical barrier – the synapse – between the neurons. This process is called synaptic transmission. The continuous configuring and reconfiguring of connections between neurons is the basis of the brain's processing ability. Each sensation experienced by the individual creates new neural connections and old connections disappear as memories or ideas fade.

There are many different chemicals in the brain that act as neurotransmitters but a small group are most involved. These include dopamine (regulating movement, pleasure, energy), epinephrine or adrenaline (arousal and alertness), serotonin (regulating mood) endorphins (pain relief). Some of these are particularly linked to learning. Serotonin, for example, has been shown to both promote and inhibit learning.[133] Drugs usually affect inter-neuron communication by enhancing or interfering with the activity of neurotransmitters and receptors within the synapses of the brain.

## Synaptic plasticity

The brain is constantly changing and people's ability to learn and form memories comes about because of the ability of neurons to change the way in which they communicate with each other. This ability to change is called synaptic plasticity; a term describing the ability of the connection (synapse) between two neurons to change in strength. "Plasticity" simply indicates an ability to change. Cells' response to the release of neurotransmitters is not necessarily always the same but may be made stronger or weaker. Various mechanisms cooperate to achieve synaptic plasticity including changes in the quantity of neurotransmitter released into a synapse and changes in how effectively cells respond to those neurotransmitters. Long term potentiation (LPT) describes an increase in synaptic strength such as that which occurs when neurons are stimulated during an intense mental activity, such as learning a new task. The opposite can also occur and long term depression (LTD) represents a decrease in synaptic strength. Synaptic plasticity is important because individuals' memories are represented by interconnected networks of synapses in the brain, so synaptic plasticity is one of the important neurochemical foundations of learning and memory. Research has shown that manipulation of the LTP effect positively affects memory. Pharmaceutical companies are particularly interested in the possibility of using the research findings on synaptic change to develop new compounds which can improve memory. Synaptic plasticity occurs in various parts of the brain, including the hippocampus where short-term memories are encoded and the neocortex which is involved in long-term memory storage. One of the big challenges for neuroscience is to determine how synaptic plasticity and learning and memory are linked.

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