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Cognitive Enhancement

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Cognitive Enhancement: Social and Public Policy Issues

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Introduction to Cognitive Enhancement

Abstract: *After discussing what cognitive enhancement (CE) is and how it differs from therapy, this chapter will provide an overview of a range of nootropic drugs, devices and procedures that are, or are proposed to be, used for enhancement. Those covered include: methylphenidate; modafinil; amphetamines; beta-blocking drugs such as propranolol; donepezil; brain games; neurofeedback; transcranial direct current stimulation; transcranial magnetic stimulation; deep brain stimulation; and brain-computer interfaces (BCI). It then summarizes the latest scientific data on the efficacy of these interventions. It also includes an analysis of the current prevalence of CE use.*

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Rapid advances in cognitive neuroscience and converging technologies have created a vigorous debate over cognitive enhancement (CE) (Saniotis, 2009; Cakic, 2009; Farah et al., 2014). Although there are strong opposing views over the ethics of enhancement, there is little doubt that such endeavors will proliferate in the coming decade. In a highly competitive society where the difference between winning and losing is measured in miniscule degrees, demand for any enhancement edge is inherently strong, driven by the high economic stakes of a thriving enhancement industry. Moreover, we live in an era dominated by forces that create 'needs' through captivating marketing of products promising a better life. Marketing of these products through the media and the Internet is already active and, absent regulation, will escalate. Despite the controversy over CE, therefore, it will be alluring to many individuals and democratic governments will be hard pressed to limit its use. As noted by Martin et al. (2011), although the debate over CE continues within the scientific community and among bioethicists, it has created the expectation of an inevitable increase in the pursuit of CE, that this widespread usage will change the way we live our lives and that the future will bring new ways of enhancing, controlling and reading the brain.

This book focuses on the public policy dimensions of CE and places a wide array of enhancement techniques in a social context. Since CE is likely to become more commonplace in the near future, it will progressively generate a range of policy issues. Importantly, since different interventions involve more or less risk to the user and vary in effectiveness, it is counterproductive to lump all potential new enhancement methods into one category (Coenen, 2008). The more intrusive and risky the procedure or drug, the closer the policy attention should be. There is also a need to balance the individual right to self-improvement with the numerous social costs that could arise. While enhancement technologies are in various stages of research and development and some are likely to have no real enhancement capacity, many observers stress the need for expanded research efforts (Bostrom and Roache; 2009; Dubljević et al., 2015). Meanwhile, as we will see later, the media tends to exaggerate the positive effects of CEs and downplay or ignore the negative effects (Partridge et al., 2011). Because the broader policy implications are extensive and touch many areas of human existence, these techniques must be scrutinized as to their impact on the individual and society as a whole. Any such dialog is likely to increase demands for some level of government involvement in enhancement techniques (Greely and Illes, 2007; Kulynych, 2007).

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Among the many books on CE published in the last few years are Savulescu et al. (2009), Glannon (2011), Hildt and Franke (2013), Cohen Kadosh (2014), Muriithi (2014) and Knafo and Venero (2015). Although some have touched on public policy, most have focused on ethical or scientific issues. The move of CE to the policy domain alters the context by bringing to the forefront political considerations and divisions and placing the resolution of these issues in the milieu of interest group politics. This short book attempts to provide a start in developing a balanced policy framework for addressing these issues. After defining CE and providing an overview of its methods and prevalence in this chapter and reviewing the ethical issues and social context of enhancement in Chapter 2, the last two chapters of this book explicate the political and policy dimensions. Chapter 3 presents the range of policy options for CE and examines why it will be difficult to get on the policy agenda, especially in the U.S. Chapter 4 provides a preliminary framework for analysis of the various CE methods. Regulatory and research needs are emphasized.

Defining Cognitive Enhancement

At first glance, CE would appear to a casual observer to be a fairly straightforward concept. However, given the plethora of CE methods and the sweeping scientific, ethical, social and political issues they raise, it is soon obvious how complicated, and provocative, it actually is. While the line between enhancement and therapy is often hazy, many applications embody attempts to enhance human traits or performance rather than treat disease or promote health (Miller and Brody, 2005; Talbot, 2009). Because the distinction between therapy and enhancement is often difficult to discern in practice, it could even be argued that it lacks practical significance (Bostrom and Sandberg, 2009). According to Repantis and colleagues (2010), the term neuroenhancement refers to improvement in the cognitive, emotional and motivational functions of healthy individuals through drugs or other means. Singh (2005) adds that enhancement technologies are those treatments that improve human performance, appearance or behavior where such improvement is not medically warranted. De Jongh and colleagues (2008) distinguish among: (1) cognition-enhancing drugs used to improve short- and long-term memory or executive functioning that manages other cognitive processes and is involved in planning, cognitive flexibility, abstract thinking, and inhibiting inappropriate actions; (2) drugs that enhance

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mood and pro-social behavior; and (3) drugs that prevent the consolidation or reconsolidation of unwanted (traumatic) memories. To date, most attention has focused on the first use (Banjo, Nadler and Reiner, 2010). Neuroenhancement has also been termed cosmetic neurology (Chatterjee, 2007).

Cognitive Enhancement as therapy

In much of the literature, especially the scientific, CE is used to describe efforts to improve cognitive function by reversing or compensating for deficits in intellectual function that are found with most mental illnesses and neurological disorders (Forlini et al., 2013). In developmental disorders such as attention-deficit hyperactivity disorder (ADHD), drugs acting on the noradrenergic and dopaminergic systems, such as methylphenidate, are now in widespread use (Husain and Mehta, 2011). Similarly, for neurodegenerative disorders such as Alzheimer's, Huntington's and Parkinson's diseases, acetylcholinesterase inhibitors and memantine have become standard treatments. Furthermore, a wide range of drugs are being assessed for CE in chronic mental disorders such as schizophrenia where cognitive deficits are separable from positive (e.g. hallucinations and delusions) and negative (e.g. blunted affect) symptoms, and because current antipsychotic treatments have little, if any, impact on cognitive impairments. For many patients with schizophrenia, cognitive difficulties are the main factor limiting rehabilitation and quality of life, particularly after clinical symptoms have abated (Turner and Sahakian, 2008). In some schizophrenics even small improvements in cognitive functions could help them make the transition to independent living.

Similarly, attempts to ameliorate cognitive deficits following stroke are being actively explored (Hsieh, 2015; Wang et al., 2014). Many stroke patients struggle with simple everyday activities that require concentration, memory, problem-solving and planning. Thus, the potential public health benefit of improving current treatments for cognitive disabilities in patients is clear. Long-term drug use is also associated with a wide-range of cognitive impairments, including many executive-control functions, response inhibition, working memory and sustained attention. Although there is relatively little research assessing the capacity of cognitive enhancement treatments to improve substance use outcomes via their modulation of cognition, various medications including modafinil, atomoxetine and methylphenidate are viewed as having promise in the treatment of addictions (Sofuoglu et al., 2013).

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The term cognitive enhancement also has been used to refer to efforts to augment cognitive function among the healthy elderly. Cognitive decline and memory impairment accompanies age-related changes in the brain and could indicate the onset of dementia (Bibb et al., 2010), but many in the booming aging population without dementia worry about losing cognitive abilities and they represent a huge growing market for some enhancement products. Cognitive enhancement is viewed as a key strategy to slow the effects of aging on brain function and improve everyday functioning in multiple domains (Harvey and Keefe, 2015). Epidemiological evidence suggests advantages of the inclusion of cognitive training as a daily activity as a lifestyle intervention against cognitive aging (Strenziok et al., 2014). Many methods for enhancing neurocognitive functioning in healthy elderly populations, including the use of brain games, pharmaceuticals and stimulation methods, have been used (Taya et al., 2015). Although most of the reported positive effects of drugs and other approaches to enhancing cognition in these areas have been modest in magnitude overall and are highly variable across individuals, they have generated interest in CE, not only for patients with brain disorders, addictions or the elderly, but also for healthy individuals who want to increase cognitive function. Although it is very difficult to untangle cognitive therapies from CE, this book will focus on the more narrow use of the term as it applies to healthy individuals.

CE here, then, is achieved when cognitive abilities are improved above what is considered to be 'normal-range' functioning for human beings. The resulting dichotomy between traditional therapy and enhancement, when drugs that have been developed for the treatment of diseases and disorders have applications outside of medicine for the enhancement of healthy individuals, however, causes problem with many physicians opposed to prescribing CEs, on the basis that these products do not treat any illness and are, therefore, outside the scope of medical practice (Banjo et al., 2010; Mendelsohn et al., 2010; Schelle et al., 2014; Bergstrom and Lynoe, 2008). Some physicians have reported that they would feel comfortable for those with cognitive disability to use CE products for treatment purposes, but that it is inappropriate for healthy individuals to be using such products (Franke et al., 2012). Where this distinction between 'cognitively disabled' and 'normal functioning' lies is unclear, and will likely become more ambiguous as our cognitive traits continue to be pathologized (Conrad and Horwitz, 2013; Coveney et al., 2011; Schanker, 2011).

Furthermore, it can often be difficult to categorically determine whether an individual is 'normal', or suffering from a psychiatric condition requiring

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treatment, because many psychiatric diagnoses present as spectrum disorders. If we are going to posit differences between treatment and enhancement, we need a clear conceptualization of the point at which treatment becomes enhancement which, in turn, hinges on the definition of normal (Turner and Sahakian, 2008). Given the slipperiness of the distinction, Savulescu et al. (2011) argue that instead of trying to determine whether certain drugs or certain of their effects constitute treatment or enhancement, it is more logical and useful to think of a continuum of wellbeing which can be increased or diminished by various interventions. Maslen et al. (2014), for instance, envision a sliding scale from interventions that are intended simply to sharpen a certain cognitive skill in a healthy person to those intended to relieve a person of pain or another burden that significantly affects his or her ability to pursue the normal range of activities.

As Nagel (2010) has noted, this growing and ever more finely-tuned capacity to tamper with normally-functioning neural systems raises a number of ethical questions about the boundary between traditional research/clinical practice and outright human enhancement. Moreover, Mehlman and Berg (2008) warn that the distinction between enhancement and health-oriented research is not a bright line. A working definition of CE is that it is an intervention that employs medical and biological technology to improve performance, appearance or capability. Often, an enhancement will place a person above the population norm, but this need not always be the case. If an individual started out within the normal range, for example, an improvement would be an enhancement even if it left the individual within the normal range. Moreover, the concept of 'normality', is itself elusive and may vary widely from place to place and time to time. One of the issues surrounding CE discussed in Chapter 2 is whether CE itself will alter the concept of normality.

Under the more narrow definition of CE used here, an enhancement does not aim to prevent, treat or mitigate the effects of a disease or disorder. In essence, then, it is defined as any improvement or extension of mental capabilities or performance in the absence of clinically defined illness (Schermer et al., 2009). However, the concepts of disease and disorder themselves are also hard to pinpoint, especially with the tendency to regard more and more health states as diseases and, thus, more interventions as treatments (Nagel, 2010). Invariably, there will be borderline cases and disagreement among observers. From a sociological perspective, the distinction between therapy and enhancement is difficult to uphold because the concepts this distinction is based upon (i.e. normal, health, disease, etc.) are so difficult to establish and variable over time (Ball and Wolbring, 2014).

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Medicalization of CE

Cognitive enhancement is further complicated by medicalization (Coveney et al., 2011; Schanker, 2011). Over the past three decades in Western medicine, a vast medicalization has occurred where behavior and conditions become defined or treated as medical (Conrad and Horwitz, 2013). A physical, biological or psychological condition or behavior is said to be 'medicalized' when it is described within a medical framework, given a medical label as an illness or disorder or treated with a medical intervention (Conrad and Horwitz, 2013). According to Coveney and colleagues (2011), the pharmaceutical and biotechnology industries are said to have played a major role in redefining normal behavior and states as medical problems that warrant pharmaceutical treatment.

Frequently, medicalization of a problem is linked to the availability and profitability of a treatment for it, buoyed by a growing consumerist orientation to health care (Ableson et al., 2007). Reinforced by enthusiastic media reporting and direct-to-consumer advertising in the U.S., an increasing number of patients pressure their physicians to prescribe the drug, thus lowering the threshold where patients are deemed suitable to receive treatment for specific symptoms (Conrad and Horwitz, 2013). Moreover, Internet sites enable consumers to access CE products without the need to visit a doctor, illustrating medicalization via the application of a medical solution to an everyday problem without the direct involvement of medical professionals. While there is apprehension about the direction of current and future biotechnologies, the increasing use of these technologies in defining human beings is probably inevitable, primarily due to the medicalization of the human body in Western medicine which tends to view the human body as a machine (Saniotis, 2009).

More recently the term biomedicalization has been introduced to describe the transformations in medicine and of bodies through technoscientific interventions that are used not only for treatment but also increasingly for enhancement or optimization (Clarke and Shim, 2011). The customization of bodies through tailor-made medicines, technologies and cosmetic surgery, in addition to the proliferation of 'lifestyle' drugs, are viewed as marking the move away from medicine-as-therapy towards medicine-as-enhancement (Conveney et al., 2011). Within a medicalization framework, the term enhancement can be broadly translated as an 'improvement' to body, mind or performance: something which adds to, builds upon and extends one's existing capabilities. However, in this view, every treatment can also be

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considered to be a form of enhancement (Synofzik, 2009) encompassing therapeutic as well non-therapeutic effects. 'The medicalization thesis can thus be used to explain how, when viewed through a medical framework, human behaviours and cognitive states can come to be understood as abnormal and how new pharmaceutical technologies can then be positioned as legitimate therapies to normalize, correct or repair specific aspects of cognitive functioning. Medicalization, is then, linked to legitimacy of both the therapeutic target and the use of the technology to treat it' (Coveney, Williams and Gabe, 2011). Using the concepts of medicalization and biomedicalization can help explicate how biomedical interventions can come to be legitimated for use by healthy people by shifting emphasis from treating illness to optimizing one's life chances (Clarke and Shim, 2011).

For a new drug to be proven effective in clinical trials and gain regulatory approval, it must target a definable illness or disorder to measure improvements against. As a result, new diseases or disorders may be created in order to legitimize new medical treatments and interventions. This leads some to speculate that we live in a society where there is an 'ill for every pill' as pharmaceutical companies attempt to increase the markets for their products and legitimate consumption (Busfield, 2010). It has been argued that the rise in profile and availability of so-called lifestyle drugs is contributing to the pharmaceuticalization of daily life as consumers come to see such substances as 'magic bullets' to resolve their everyday problems (Fox and Ward, 2009). There are several documented cases of drugs developed to treat specific diseases that have crossed over from therapies to common usage for enhancement purposes where no medically-defined need can be identified. For example, the drug Ritalin, which is marketed as a treatment for ADHD, reportedly, is now widely given to children who do not qualify medically as ADHD sufferers and used by high school and college students as a study aid. Similarly, it has been claimed that there is already a significant amount of drug taking among academics with the goal of improving cognitive performance or stamina (Maher, 2008). Despite the limited amount of empirical evidence available, this demonstrates how, although pharmaceuticals might be developed as medicines to treat a genuine primary disease indication and accessed via medical professionals, their usage can extend far beyond the treatment of disease to become a means of enhancing various aspects of social life (Williams et al., 2011).

According to Barbara Sahakian, 'The drive for self-enhancement of cognition is likely to be as strong if not stronger than in the realms of enhancement of beauty and sexual function' because 'we are a society that

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so wants a quick fix that many people are happy to take drugs' (quoted in Talbot, 2009). For the time being, people looking for this particular quick fix have a limited choice of medication, but that will likely change given the economic stakes involved. New psychiatric drugs have had a way of creating markets for themselves. Disorders often become widely diagnosed after drugs become available that can alter a set of suboptimal behavior. One example is the emergence of a new disease and susceptibility category of mild cognitive impairment (MCI) (Williams et al., 2011). MCI is a label that is used to describe individuals who do not meet diagnostic criteria for dementia, but who exhibit some mild cognitive deficits and are thought to have a greater than normal risk of progressing to dementia. This example not only elucidates how blurry the boundaries between what is considered to be normal and abnormal cognitive functioning are and how these can shift over time, but also the new focus on risk and lifestyle as a valid site for biomedical intervention in the biomedical era (Coveney et al., 2011).

Technology fix mentality

Western culture, then, is predisposed toward progress through technological means. In our attempts to overcome disease and illness, we have always stretched the boundaries of intervention into the human body. In many ways, this continual expansion of our ability to intervene has, in fact, defined progress and, therefore, seldom has been seriously questioned. The rapid developments directed at giving us greater control over what it means to be human have taken on a new urgency but, to date, have been met with little assessment as to where there are leading. Our ingrained dependence on technology to cure human problems, many of which have complex social causes, has translated into a potent desire to find quick technological fixes to our perceived shortcomings. Moreover, the search for cures for diseases readily has given way to demands for improvements on nature and for control over the aging process through a technological fountain of youth. We strive for perfect bodies through chemicals and cosmetic surgery, for enhanced mental powers through CE, and for replacement of worn out body parts through a range of implant devices.

Extensions of this mode of thinking into the realm of CE are natural extensions of cosmetic surgery. Although many of the applications of cosmetic surgery do not address health problems, by packaging it as health care, we in effect have medicalized physical appearance. CE promises to do the same for the brain (Horn, 2008). The technological fix mindset also assumes that

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most of the physical and even mental ills of life are avoidable and can be prevented or cured on a medical model that applies quick or simple fixes through pills, surgeries or other means. Since this is exactly what commercialized technology seeks to offer (see Chapter 2), there is a good fit between the desire of the public and products that promise shortcuts to achievement of one's goals and a public-driven incentive for optimism or hype about CE potential (Caulfield and Condit, 2012).

Many supporters of CE argue that enhancement with drugs is just a new method of doing what human beings have long done: use technology to improve themselves (Blitz, 2010). Greely et al. note that cognitive-enhancement drugs and newer technologies such as brain stimulation and prosthetic brain chips, 'should be viewed in the same general category as education, good health habits, and information technology – ways that our uniquely innovative species tries to improve itself' (2008: 702). Many authors agree that enhancement technologies are not as novel as some claim, and, thus, merit the same treatment as technologies before the era of CE. Levy (2007) agrees, but also warns that not all forms of CE merit the same analysis. Rather, we must assess each enhancement technique separately within the context in which they are used and examine the details of their application before we accept or reject them.

A number of conventional lifestyle interventions are proven cognitive enhancers for improving attention, problem-solving, reasoning, learning, memory and even mood. According to Kelly (2015), many of these interventions, such as physical exercise, cognitive, mental and social stimulation, may be described as environmental enrichments of varying types. Use of these non-pharmacological cognitive enhancers circumvents some of the ethical considerations associated with pharmaceutical or technological CE, being low in cost, available to the general population and presenting low risk to health and wellbeing. For instance, from a population health perspective, Lucke and Partridge (2013) present many modifiable healthy lifestyle factors that can optimize cognitive functioning and for which there is evidence of safety and efficacy, including: promoting adequate sleep; increasing physical activity; encouraging a healthy diet; minimizing consumption of stimulants, alcohol and other drugs including nicotine and promoting good mental health. Moreover, they argue that it is not ethical to promote or sanction the use of pharmaceutical drugs as cognitive enhancers without acknowledging the adverse effects on population cognitive health of failing to encourage the pursuit of healthy behavior. As Levy (2012) has argued, when faced with a detrimental mismatch between our capacities and our context, all things

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considered it is better to change our environmental conditions than it is to re-tool our biology. In the end though, the best course of action might be to pursue a complementary strategy that involves the use of brain-level interventions alongside more conventional approaches (Savulescu and Sandberg, 2008).

Cognitive Enhancement techniques

Figure 1.1 illustrates the wide array of potential enhancement factors. As Bostrom and Sandberg (2009) note, 'conventional' modes of CE such as education and mental training, improved general health and sleep, caffeine and energy drinks are largely accepted by society. In contrast, 'unconventional' methods such as nootropic drugs, electrical stimulation or neural implants tend to evoke moral outrage, even though the line between them is problematic (also see Dresler et al., 2013). In fact,

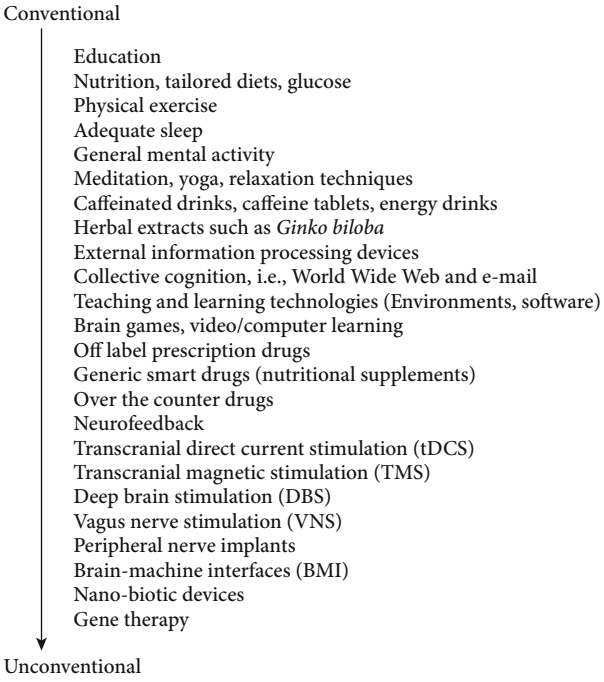

FIGURE 1.1 *Spectrum of Cognitive Enhancement*

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as Bostrom and Roache (2009) argue, the boundary between these two categories will increasingly become muddled. For instance, neurological health objectives such as maintaining full cognitive performance into old age, or remedying specific cognitive deficits such as a concentration and memory problems, are likely to become increasingly hard to distinguish from enhancement objectives as the range of available biomedical interventions expands. Moreover, one could argue that computerized brain games are simply contemporary forms of education.

Conventional methods of CE

Nutrition: Although evidence remains limited, many food products and dietary supplements claim to increase energy or improve memory (Dresler et al., 2013). Subjective reports of increased mental energy are associated with higher glucose metabolism in the brain that occurs within several minutes after ingestion. In terms of objective cognitive performance, glucose improves attention, response speed and working memory, the latter occurring under conditions of high but also under low glucose depletion (Jones et al., 2012). The most pronounced effects of glucose on cognition have been found for declarative memory (Smith et al., 2011).

Caffeine: Caffeine is an adenosine receptor antagonist that exerts its stimulating effects less than an hour after administration through altering the biochemistry of the brain. Although it improves motor-skill performance on tasks that are impaired when arousal is low and increases speed of encoding and response to new stimuli, its effects on more complex and cognitively demanding tasks remain controversial in that some authors report better performance but also null-findings effects (Dresler et al., 2013). The effects of caffeine on memory and learning are particularly disputed and positive effects can be in large part attributed to indirect effects from elevated attention to the stimuli during encoding (Nehlig, 2010). Moreover, some studies have associated caffeine withdrawal after heavy coffee consumption with headaches, increased subjectively perceived stress, feelings of fatigue and reduced alertness.

Physical exercise: A growing body of evidence suggests that regular aerobic exercise has beneficial effects on brain function and cognition (Hillman et al., 2008). The focus of most studies on physical exercise effects on cognition is on developmental issues where either children of different age groups or elderly adults were examined. A recent meta-analysis of randomized controlled trials demonstrated that aerobic exercise training improves

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attention, processing speed, executive function and memory, while effects on working memory were less consistent (Smith et al., 2010). Moreover, unlike drugs and brain stimulation, there are numerous other health benefits from physical exercise.

Sleep: A wide body of literature suggests that an important function of sleep is to enhance cognitive capacities. Hundreds of studies have confirmed the positive effects of sleep on memory consolidation (Diekelmann and Born, 2010). Even a nap as short as six minutes has been shown sufficient to promote memory performance. Anecdotal reports on scientific discovery, inventive originality and artistic productivity suggest that also creativity can be triggered or enhanced by sleep.

Meditation: Meditation has been conceptualized as a family of complex emotional and attentional regulatory training regimes and includes ancient Buddhist mindfulness meditations such as Zen as well as modern group-based standardized meditations (Chiesa and Malinowski, 2011). Recent research suggests that meditation benefits several cognitive capacities. Even a brief training of just four meditation sessions was sufficient to significantly improve visuo-spatial processing, working memory and executive functioning (Zeidan et al., 2010).

Mnemonics: This term is typically used to denote internal cognitive strategies aimed to enhance memory. Mnemonic strategies can be seen as strong and reliable enhancers of learning and memory capacity. While their immediate benefits for easy-to-learn material seem to be in the small to medium effect size range, the effectiveness of mnemonics grows significantly with task difficulty or retention time (e.g. Karpicke and Roediger, 2010). Another strategic method to enhance memory retention that has gained attention in recent years is retrieval practice.

Computer-based training

There are three popular computer-based approaches to improving cognition: brain-training programs; working-memory training; and video-game training (Boot and Kramer, 2014). Computer-based cognitive training software, popularly known as brain games, is aggressively marketed, especially to ageing adults and the parents of young children. Products in this billion-dollar industry include Cogmed, CogniFit, Posit Science, Nintendo's Brain Age and Lumosity, which has over 60 million members. The promotion of these products reassures and entices a worried public. Consumers are told that playing brain games will make them smarter, more alert and able to

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learn faster and better. In other words, the promise is that if you adhere to a prescribed regimen of cognitive exercise, you will reduce cognitive slowing and forgetfulness, and will fundamentally improve your mind and brain. It is customary for advertising to highlight the benefits in rather abstract terms (Ghoravshi, 2014) and assure consumers that claims and promises are based on solid scientific evidence, as the games are designed by neuroscientists at top universities and research centers.

Over the past decade, some commercial and custom video games have also generated excitement about their potential to improve a variety of perceptual and cognitive abilities. Some researchers have linked superior attention, vision, processing speed, dual-tasking ability and decision making to action-game play through cross-sectional studies comparing gamers to non-gamers, intervention studies training non-gamers to play action games, or both (Powers et al., 2013). Other studies have suggested that game training could ameliorate age-related cognitive decline (Basak et al., 2008). Although some studies have found computerized training programs to produce moderate improvements in memory and attention (Zelinski et al., 2011) and executive function and processing speed (Nouchi et al., 2012), a large online study did not find any evidence for transfer (Owen et al., 2010).

To be successful, however, any cognitive training program must demonstrate that any positive effects of training are transferable to untrained practical cognitive functioning for extended periods of time (Bavelier et al., 2012; Jaeggi et al., 2008). Does extended practice of the trained games result in general perceptual and cognitive improvements that boost performance of meaningful, real-life tasks, or does it simply make you better at the game? It is of great importance to succeed in reproducing the improved performance gained from training in one task, to another, different task with no prior training on the second (Karbach and Schubert, 2013). Empirical evidence that certain software packages and digital games are capable of improving perceptual and cognitive abilities that transfer to untrained tasks is mixed. Some studies had positive results, while others did not, but even in studies with positive results, interpretations of transfer effects are not always straightforward and many have proven difficult to reproduce or have been disproven altogether.

Improved performance on untrained, but directly related tasks to the trained task is called 'near transfer', while improvements on untrained tasks which are related, but not directly related to the cognitive abilities is called 'far transfer'. Although several studies have shown the possibility

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of such far transfer of practice effect beyond task-specific performance (Klingberg et al., 2002), it generality remains controversial (Ackerman et al., 2010; Dresler et al., 2013; Strenziok et al., 2014). In fact, a recent meta-analysis of 23 investigations of memory training by international research teams (Melby-Lervåg and Hulme, 2013) demonstrated that they failed to lead to significant broader effects. In other words, only a few studies have demonstrated improvements in untrained tasks within the trained cognitive domain, non-trained cognitive domains or on measures of everyday function. Additionally, many studies of these programs are hindered by methodological limitations such as lack of an adequate control group, long-term follow-up and ecologically valid outcome measures (Jak et al., 2013). Moreover, there is a well-known bias across scientific disciplines for reporting positive effects: studies that show no effect are less likely to be published, and so the overall picture may be skewed towards showing success where it does not really exist (Ghoravshi, 2014). Van Ravenzwaaij et al. (2014), for instance, found that, in contrast to earlier reports that playing action video games leads to faster information processing and reduced response caution (Green et al,. 2010), playing action video games does not improve the speed of information processing in simple perceptual tasks. In contrast, Purcell and Rommelfanger (2015) suggest that Internet brain-training programs, where consumers serve as both subjects and funders of the research, represent the closest engagement many individuals have with neuroscience. McKendrick et al. (2014) examined the effects of working memory training on brain function and behavior. They monitored subjects using near infrared spectroscopy (NIRS) while they performed a dual verbal–spatial working memory task. Changes in cerebral hemodynamic of the left DLPFC and right VLPFC were found to be associated with time spent in training.

Advertisements for brain game products typically feature product users, or actors portraying users, discussing why they are using the product and how they changed their life. The companies' websites also tend to feature user anecdotes, as well as a section explaining the science behind their product and referencing academic studies. In many instances, however, the original studies examine something other than the program being advertised, assessing benefits with abstract laboratory tasks rather than everyday ones, and often lack critical control conditions necessary to causally link improvements to the product (Boot and Kramer, 2014). While pharmaceutical advertisements are strictly regulated, brain-fitness program advertisements are not.

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Concerns over the marketing claims by some of these companies led a group of 73 international psychologists, cognitive scientists and neuroscientists to write an open letter accusing them of exploiting customers by making 'exaggerated and misleading claims' that are not based on sound scientific evidence. They conclude:

> We object to the claim that brain games offer consumers a scientifically grounded avenue to reduce or reverse cognitive decline when there is no compelling scientific evidence to date that they do. The promise of a magic bullet detracts from the best evidence to date, which is that cognitive health in old age reflects the long-term effects of healthy, engaged lifestyles. In the judgment of the signatories, exaggerated and misleading claims exploit the anxiety of older adults about impending cognitive decline. We encourage continued careful research and validation in this field. (Max Planck Institute, 2014)

Moreover, cognitive activity takes many forms, and there is currently little evidence suggesting that any particular software package is best at improving cognition, or that any brain-training product is better than other engaging activities, such as learning a new language or musical instrument, creative writing, or aerobic exercise (Boot and Kramer, 2014). Taya et al. (2015) suggest that one way to improve the outcome of cognitive training interventions is to use electroencephalography (EEG) biomarkers of cognitive workload using the 'connectome' approach.

Pharmaceuticals

Most attention in CE today is directed at nootropics, or 'smart pills', that act on the central nervous system to enhance the cognitive performance by improving memory, concentration, perception, attention, judgment, motivation and/or orientation. Despite considerable variation in chemical composition and in the mechanisms through which they act, a common characteristic of nootropic drugs is their activity on higher integrative brain functions (Chatterjee, 2007). They are thought to work by altering the availability of the brain's supply of neurotransmitters, enzymes and hormones, improving the brain's oxygen supply or stimulating nerve growth. Although the initial research on these drugs was designed to treat patients with dementias or other diseases, increasingly they are being touted as means of boosting the cognitive abilities of healthy persons (Singh, 2005; Husain and Mehta, 2011). Despite the lack of clear scientific evidence that they enhance normal persons, a smart drug industry is

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flourishing and the appeal of a technological short cut to learning is prevalent (Chatterjee, 2007).

An editorial in *Nature* sparked a heated debate by asserting that the use of smart drugs was not cheating as claimed by the opponents and arguing that its use represented a 'pursuit of personal liberty' to reach one's full potential (Editorial, 2007). Following up on this theme, a group of scientists and ethicists concluded that healthy people have the right to use nootropics and that society should welcome, not discourage, new methods of improving brain function (Greely et al., 2008; Makridis, 2013). Although they suggested a number of cautions and called for more research about the unknown risks of the drugs, they declared that enhancing with pills is no more objectionable than eating right or getting a good sleep. Similarly, the popular media has displayed often-unabashed support for cognitive enhancing drugs while the Internet offers thousands of sites that promise significant benefits and immediate shipment often without prescription. Until medications are developed specifically for CE in a normal population, CE will be considered an 'off-label' use which includes: (1) prescribing drugs for conditions other than those for which they were approved; (2) prescribing drugs for patient groups other than those for which they were originally approved; and (3) varying from the approved dosage or method of administering drugs (Larriviere et al., 2009).

In 1964, Corneliu Giurgea pioneered the first modern nootropic drug, piracetam, and established criteria for the first nootropic (Makridis, 2013). Although never approved for any clinical use by the FDA, piracetam has been used experimentally on stroke patients with little effect, but that has not prevented it from becoming available in the U.S. from retailers that sell supplements. Data on the benefits of piracetam for healthy people, however, are virtually nonexistent, but many users believe that the drug increases blood flow to the brain. The effects of piracetam on healthy volunteers have been studied even less than those of Adderall or modafinil and most peer-reviewed studies on it have focused on its effects on dementia or on people who have suffered a seizure or a concussion. Piracetam's mechanisms of action are poorly understood, although it is thought it might increase levels of the neurotransmitter acetylcholine. In 2008, a committee of the British Academy of Medical Sciences noted that many of the clinical trials of piracetam for dementia were methodologically flawed and another published review of the existing studies of the drug concluded that the evidence does not support its

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use in the treatment of people with dementia or cognitive impairment (Carey, 2008).

Methylphenidate (MPH) is a dopamine reuptake blocker that also enhances dopamine and norepinephrine release with pharmacologic mechanisms similar to those of amphetamines (Dresler et al., 2013; Husain and Mehta, 2011). The most common MPH, Ritalin, is a stimulant designed to treat ADHD, but, as noted earlier, there is evidence that it is commonly used by students as a study aid to improve concentration, focus for a specific task, or counteract sleep deficit or jetlag and that it has become increasingly popular in business (Emanuel et al., 2013). Indirect evidence of the non-medical use of MPH is reflected in the disproportionately high prescription and sales numbers relative to the numbers of patients suffering from the disorders for which these substances are approved, and, thus, being used off-label [Forlini and Racine (2009), however, contend that performance enhancement is actually distinct from off-label uses by physicians because its uses are neither medically prescribed nor supervised]. Despite its current usage for enhancement, in their meta-analysis of the literature on MPH, Repantis et al. were unable to find sufficient evidence of positive effects in healthy individuals from objective tests. 'The analyses of the existing studies provide no consistent evidence for neuroenhancement effects of MPH. This result is in concordance with most of the individual studies, which reported either no effects, or even negative effects, such as a disruption of attentional control' (2010: 203). However, since it is the subjective effects that motivate people to take a drug like Ritalin, not the objective results of neuropsychological assessments, those who use it for enhancement may not be influenced by the fact there is scant evidence that it works. While Ritalin appears less risky than other CE candidates, the dangers are real and relatively well known. Aside from its abuse potential, MPH may aggravate mental illness, produce sleep disturbances and is associated with cerebrovascular complications (Bostrom and Roache, 2009).

Amphetamines are a distinct class of drug that increase activity related to dopamine and norepinephrine in the brain, thus increasing alertness, wakefulness and awareness. They have been shown to increase executive functions in most healthy normal people, improving their ability to focus, manipulate information in working memory and control their responses. While amphetamines are used medically to treat ADHD, as well as obesity and narcolepsy, they are especially prone to abuse and addiction and can cause serious cardiovascular adverse events. The most immediate adverse effect is an increase in blood pressure, which could be dangerous

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to individuals who suffer from high blood pressure, and may even cause sudden death (Dubljvic, 2013). Despite these considerable risks, Adderall (which contains a combination of amphetamine and dextroamphetamine) is one of the most commonly used drugs for CE. Moreover, unlike modafinil, amphetamines cause sleep rebound – the need to make up for lost hours of sleep and create rapid effects, euphoric effects or a subsequent decrease in mood and energy.

Modafinil was first approved for the treatment of narcolepsy and is also prescribed off-label for neuropsychiatric and medical conditions such as sleep apnea and shift-work sleep disorder, as well as for healthy people who need to stay alert and awake when sleep deprived. It is already used by military personnel, as evidenced in the Memorandum of the United States Air Force (2 December 2003), which approves the use of modafinil for missions of great duration. Moreover, the prevalence of off-label prescriptions has reached 90 percent and is mounting yearly in absolute numbers in large part the result of increased public perception of enhancement effects, which the manufacturer Cephalon has been allegedly promoting illegally (Dubljević, 2015). Analysis of the effects of modafinil in healthy subjects has revealed improvements in attention, memory and executive function in sleep-deprived individuals, although this might simply be the result of improved wakefulness or arousal induced by the drug. In aggregated studies, modafinil was found to improve attention for well-rested individuals, while maintaining wakefulness, memory and executive functions. Repeated doses were unable to prevent deterioration of cognitive performance over longer periods of sleep deprivation although they did maintain wakefulness and perhaps induced overconfidence in cognitive performance (Repantis et al., 2010). Unlike older stimulants like amphetamine, modafinil poses only modest short-term risks, its toxicity is very low, it is much less likely to cause serious cardiovascular adverse events, and it is not likely to be addictive. Given the heightened work pressures in a modern society to disregard biological rhythms, it is not surprising that modafinil has gained popularity as cognitive enhancer. Thus, Dubljević (2015) suggests that the wakefulness promoting properties of modafinil might be very beneficial for the society at large by alleviating effects of fatigue during work and even freeing up new time for leisure activities.

Another CE-related application involves beta-blocking drugs, such as propranolol, that were originally devised to treat cardiac arrhythmias and hypertension and to prevent sudden death after myocardial infarction. Beta-blocking drugs compete with adrenaline-like chemicals produced by

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the sympathetic nervous system that attach to beta-adrenergic receptor sites when the body is under stress. By occupying the receptor sites, they block these physiological responses, thus reducing the symptoms of anxiety. They also appear to alleviate posttraumatic symptoms by curtailing disturbing memories (Ashcroft and Gui, 2005). Beta-blockers are prescribed to relieve clinically diagnosed anxiety, but are also reported to be widely used by musicians (Harby et al., 2014) and competition shooters to dampen physiological tremors in order to improve or enable performance. Other users of propranolol could include surgeons, students and soldiers. Although not addictive, beta-blockers can significantly worsen some medical conditions and, thus, some psychiatrists feel that beta-blockers ought to be used only as a temporary measure in the context of psychological intervention.

Drugs prescribed for the treatment of dementia, namely the acetylcholinesterase inhibitors (AChEIs) and memantine, have also been touted as a means of promoting mental agility in healthy persons (Husain and Mehta, 2011; Dresler et al., 2013). AChEIs, including donepezil, galantamine and rivastigmine, are currently recommended for clinical use for the treatment of patients with mild to moderate Alzheimer's disease and Parkinson's disease dementia. Of these, only donepezil has been trialed for CE, but Repantis et al. (2010b) found no consistent evidence for an enhancement effect. Moreover, out of 446 studies on the effect of AChEI reviewed by Repantis et al. (2010b), only 20 had results relevant to the CE of already healthy individuals. In one study, it was found that donepezil improved the retention of training on complex aviation tasks (Yesavage et al., 2002), but Wade, Forlini and Racine (2014) note that that study has been widely misinterpreted and provides a good example of how CE became and remains a topic of focused interest despite a limited body of supporting evidence. Some studies have found improvement in verbal memory for semantically processed words and episodic memory (Dresler et al., 2013), but another study actually found impairment of working memory in older healthy participants who took donepezil for six weeks (Balsters et al., 2011). In a sleep deprivation study, memory and attention deficits resulting from 24 hours of sleep deprivation were attenuated after taking donepezil although this could not be confirmed in a more recent study (Dodds et al., 2011). In the majority of the trials, donepezil was well tolerated with few side effects, however some authors warn that sleep disturbances might become apparent in larger populations (Yesavage et al., 2002).

Although virtually all attention in the academic literature has focused on off-label use of prescription drugs, more ubiquitous in terms of use and

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impact are compounds sold as natural supplements and widely marketed as CEs primarily on the Internet with few boundaries (see Chapter 3 for a discussion of the marketing). Recently, Facebook and Yahoo users may have been surprised by ads for Alleradd, a cognitive-enhancement pill that promises users the same kinds of effects of the similarly named Adderall. But while amphetamine-based Adderall is a controlled substance legally available only by prescription, Alleradd is marketed as a nutritional supplement available online to anyone with a valid credit card who states they are at least 18. In addition to caffeine, niacin, and various vitamins, Alleradd includes ingredients like the neurotransmitter GABA and plant extracts said to have nootropic powers, including vinpocetine, bacoside A and huperzine A. Companies such as AlternaScript, the makers of Alleradd, offer pre-packaged blends ready for consumers, while self-experimenters exchange messages online about how various combinations of compounds boost their mental prowess abound (Melendez, 2014). Similarly according to another website, one need not risk your health and legal standing by ordering generic modafinil from offshore drug stores when you can buy Adrafinil legally without a prescription (http://nootriment.com/modafinil-alternatives/). They state that Adrafinil is a pro-drug to modafinil, meaning that it is converted into this substance when the body metabolizes it. Supposedly, there is scientific evidence the effects are identical.

Other companies openly advertise that their products contain piracetam. One vendor, LifeLink, sells piracetam under the brand name NoöRacetam, arguing that the FDA restricts the compound and the information vendors can provide about its efficacy as part of a 'conspiracy to keep Americans ignorant'. Others sell Phenylpiracetam, a nootropic supplement derived from piracetam said to be 60 times stronger. This compound promises to increase mental fluidity and working memory by modulating acetylcholine receptors. Another derivative of piracetam is Aniracetam, which is cited as being five times more powerful, with heightened dopamine and serotonin influence. One of the downsides of Aniracetam is that it has very low bioavailability and a short half-life, meaning one must take a larger dosage than if it had better absorption into the blood. But fear not, Pramiracetam corrects some of the problems associated with Aniracetam while offering similar benefits. It is also a fat-soluble analog of Piracetam, but one that is believed to be 30 times more potent and it lasts much longer in the brain. Noopept, yet another racetam-derived compound, has a more direct mechanism of being transported to the brain, which is why this substance is considered 1,000 times more potent than the same amount of piracetam. 'The influence it

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exerts on your neurons is similar to the Racetams but with greater levels of stimulation. If you have never taken Noopept, you might be surprised by the stimulant-effect which is sometimes compared to Adderall or Ritalin.'

Another widely touted and marketed pill is Addium termed 'Viagra for the brain' and 'the most powerful brain enhancer in the world' by a group of TV 'doctors' including Dr Oz (Wilson, 2015). According to its supplier AlphaMale, Addium, has no recorded side effects in any clinical trials, but has been the target of major pharmaceutical companies who claim it is too powerful to be sold without a prescription. 'Other critics in academic circles insisted that Addium provided an artificial edge for its users and was unfair to those who weren't taking it. This led to it being banned from quiz shows like *Jeopardy!* and at many top universities such as Cambridge.' Interestingly, in almost identical ads, the same compound is called Adderin, Geniux (medical name E-Huperzine) and Alpha ZDT!

Overall, the efficacy of most nootropic substances has not been documented, and efforts to do so are complicated by the difficulty of defining and quantifying cognition and intelligence, as well as more practical limitations, such as the lack of dedicated research funding (see Chapter 4). Based on their detailed analysis of both animal and human studies on CE, Lynch, Palmer and Gall conclude that the advantages associated with such drugs are somewhat limited, mainly involving conditions in which sleepiness is factor or by artificial testing circumstances that involve heavy loads on operations that feed into cognition. But there is little reason to think that such drugs will in any sense constitute 'smart pills' – something that will give healthy, alert individuals any intellectual advantage in real world circumstances (2011). Despite the absence of scientific evidence that these substances actually work in healthy persons, however, an enhancement industry is flourishing (Chatterjee, 2007), again manifesting the widespread attractiveness of technological shortcuts to learning (Flaskerud, 2010; de Jongh et al., 2008). Moreover, according to Chorover, 'basic neuroscientific research has morphed into a branch of bioengineering (neurotechnology) that promises to deliver a remarkable array of practical innovations' (2005: 2081).

Physical techniques

Although drugs have received most attention in the CE debate, a wide array of invasive and non-invasive physical techniques have been considered as potential CE methods. At this stage, many remain highly speculative and

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controversial, but others are currently being used and some even marketed and sold as cognitive enhancers. After a brief overview of the techniques, attention will turn to the debate over their use and effectiveness.

Neurofeedback is a type of biofeedback that uses real time displays of brain activity utilizing neuroimaging with the goal of enabling the person to regulate his or her brainwave activity through a process of operant conditioning. It typically involves placing electrodes on a person's scalp to measure the electrical patterns emanating from the brain (Sulzer et al., 2013). Connected to a computer, the person receives instantaneous auditory and visual feedback about brainwave activity. The assumption is that having awareness of one's brainwave patterns enables a person to learn to reinforce or suppress different patterns of activity. Particular patterns are associated with inwardly focused attention, others with outwardly focused alertness and others still with relaxation, daydreaming and sleep. With repeated feedback training and practice, desirable brainwave patterns can usually be retrained in most people. In the clinical domain, neurofeedback is used to treat patients with ADHD, epilepsy, autism and insomnia, but increasingly, it is being used in healthy individuals to enhance attention, memory, intelligence and wellbeing. Already, there are many websites, as well as non-medical clinics, selling relatively rudimentary neurofeedback devices and equipment promising to improve cognitive performance, emotional self-regulation, concentration, attention and a host of other functions (Maslen et al., 2014). More sophisticated devices or mixed technologies are being researched. For instance, Zotev et al. (2014) combined two imaging modalities that are typically used separately for neurofeedback, EEG and fMRI, and devised a system for real-time integration of simultaneous real-time fMRI and EEG data.

Although the risks associated with neurofeedback are not as worrying as with DBS, tDCS or even TMS, it is not risk-free. In some people, neurofeedback training can lead to headaches, muscle twitches, tics, mental bewilderment and sleep disturbance. It appears that others are vulnerable to over-training, resulting in a transient decrease in cognitive functioning and other side effects. Furthermore, due to the heterogeneity in the brainwave activity, unless the training is carefully tailored to the individual, there is a risk that it will be ineffective or even produce an adverse reaction (Hammond, 2010). Some neurofeedback devices already function as video games; for instance, Emotiv markets a headset that allows gamers to control video-game activity by generating certain brainwave patterns. Another neurofeedback device, the 'Attention Trainer', utilizes a video game to help

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people control ADHD symptoms by rewarding high-attention states and discouraging distracted ones (Blitz, 2010).

Although less extensive than the literature on nootropics, there is mounting interest in direct physical interventions such as deep brain stimulation (DBS), where electrodes are implanted in deep brain structures and used to modulate their activity through high frequency stimulation, in order to enhance cognitive abilities (Hamani et al., 2008; Pacholczyk, 2011). Although Synofzik and Schlaepfer (2011) contend that the widespread use of DBS for enhancement purposes is highly premature, they envision a potential future use. However, in their study of the attitudes of neurosurgical staffs toward its uses, Mendelsohn et al. (2010) found little support among physicians for using DBS for CE, with most respondents finding physical alteration of non-pathological traits as objectionable. This is crucial since, unlike drugs, professionals must participate directly in the enhancing process (Banjo et al., 2010).

Suthana and Fried (2014) contend we need consistent methodologies across studies to facilitate systematic comparisons and contribute to the understanding of DBS and its effects on learning and memory and whether it will be even a useful therapeutic treatment for patients with memory disorders, much less CE. Moreover, although DBS is not synonymous with mind control, as some suggest, if not appropriately safeguarded patients could become victims of a sort of mind control, especially in the case of serendipitous treatment of co-morbid psychiatric illnesses (Koivuniemi and Otto, 2014). A more general concern is that, while DBS is a relatively safe surgical procedure, complications may include bleeding in the brain, stroke, infections and heart problems. Moreover, side effects associated with DBS use could include seizures, headaches, insomnia, memory problems and mood changes such as mania and depression (Mayo Clinic, 2014) while a significant number of patients with long-term DBS treatment have exhibited hardware-related problems in addition to complications from the initial surgery (Dresler et al., 2013). There are also anecdotal reports of DBS causing personality changes such as gambling and sartorial behavior (Ford and Kubu, 2006).

A related technique, direct vagus nerve stimulation (dVNS), directed at afferent vagal fibers appears to modulate the central nervous system, perhaps by stimulating brainstem structures. As with DBS, the stimulating signal is typically generated by a pacemaker-like device in the case placed under the chest skin. Also, while both methods have the disadvantage of requiring surgery, unlike the non-invasive methods, they can provide continuous

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stimulation (Dresler et al., 2013). In addition to being invasive, DBSs (and dVNS) are costly, making equal distribution challenging. As a result, most attention has turned to non-invasive stimulation techniques, especially transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS).

TMS employs a coil to deliver brief magnetic pulses to the scalp, inducing electric currents in the targeted areas of the brain (Hsieh, 2015). Various modalities (single-pulse, paired-pulse, high and low frequency repetitive) are available and have different cognitive effects, including interference with activity as well various forms of enhancement (Hoogendam et al., 2011). While the effects of a single TMS session may only last a few milliseconds, multiple pulses may induce long-term potentiation or depression in the target cells. A recent development has been the use of rapid bursts of pulses, such as theta-burst stimulation (TBS), which can have contrasting effects on excitability depending on the temporal pattern of the bursts (Huang et al., 2005). The effects are likely mediated by similar changes in excitation and inhibition, which in turn might involve changes in synaptic plasticity (Davis and van Koningsbruggen, 2013).

To date, over 60 studies of TMS enhancement have reported significant improvements in speed and accuracy in a variety of tasks involving perceptual, motor and executive processing, although only for short periods of time (Luber and Lisanby, 2014). Wang et al. (2014) used targeted non-invasive electromagnetic stimulation to modulate human cortical-hippocampal networks and found they could be enhanced non-invasively, thus demonstrating their role in associative memory. Although augmentation of brain function by TMS primarily centers on restoration of functions lost due to pathology or injury, recently clinical applications in otherwise healthy people are on the rise (Nelson et al., 2014; Cantarero et al., 2015; Clark and Parasuraman, 2014). However, while TMS appears to be quite versatile and minimally invasive, there are risks of triggering epileptic seizures and the effects of long-term use are unknown. Thus, unlike tDCS, it remains indeterminate whether TMS will ever be a particularly valuable enhancement method (Luber and Lisanby, 2014).

In research originally funded by the U.S. Defense Advanced Research Projects Agency (DARPA), scientists found that tDCS could heighten learning (Fox, 2011; Dubljević, 2014). TDCS is considered a non-invasive technique in which a device sends a small direct current between electrodes placed on the scalp above the area that the experimenter is interested in affecting, to stimulate or inhibit spontaneous neuronal activity

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(Stagg and Nitsche, 2011). Weak electrical currents, usually in the order of 1–2 mA, are then applied constantly for about ten to 20 minutes and pass painlessly through the scalp and skull to alter neural activity (Maslen et al., 2014). It is assumed that the currents increase neuroplasticity, making it easier for neurons to fire and form the connections that enable learning. Reis et al. (2009) found that tDCS can improve the ability to learn a simple coordination exercise with the improvement still apparent three months later. In a review of the use of tDCS to enhance attention, learning and memory in healthy adults, Coffman et al. (2014) found numerous studies where tDCS has been successful in augmenting cognitive function with many practical applications such as enhancing sustained attention or vigilance (Nelson et al., 2014). However, in their review of over 30 studies, Horvath et al. (2015) concluded that tDCS generates little-to-no reliable neurophysiologic effect beyond MEP amplitude modulation in healthy subjects. In a series of studies, Clark and various colleagues, nevertheless, found that tDCS guided by neuroimaging can produce an approximate doubling of performance accuracy that lasts at least 24 hours after stimulation and leads to an increase in attention, learning and performance. They attribute the large effect they found, as compared to other studies, to their employment of neuroimaging to optimize the effects of tDCS, concluding that the combination of neuroimaging and neurostimulation can enhance both techniques (Clark and Parasuraman, 2013). Other studies have reviewed the impact of tDCS on working memory Ferrucci and Priori (2014), treating symptoms of neurological illness (Flöel, 2014) and psychiatric illness (Kuo et al., 2014).

The relatively low cost and ease of manufacture of tDCS units has led to a movement in so-called DIY tDCS for self-stimulation and created apprehension over uncontrolled amateur use/abuse and the lack of professional supervision (Dresler et al., 2013). Moreover, anecdotal evidence suggests that some people are trying to perform tDCS without proper equipment. Thus, there is a clear risk of premature use of the technology based on misleading hype, including by vulnerable groups such as children. Furthermore, according to De Ridder et al. there is currently 'no substantive evidence that CEDs produce lasting effects outside of research and clinical settings' (2014: 320). This is a cause for concern, because long-term effects on brain plasticity and development are unknown (Kadosh et al., 2012). Despite these questions, tDCS is now widely marketed online as brain stimulation device for CE (see Chapter 2) without being held to anything more than basic product safety requirements (Maslen et al., 2014). There are

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many websites through which it is possible to purchase a device or he components for building a device. One entrepreneur has developed and marketed the 'thinking cap', a tDCS device to 'improve creativity' (Chi and Snyder, 2011). Furthermore, some non-medical clinics offer tDCS as an experimental therapy to help with 'anxiety and mood; cognitive performance (learning, memory, concentration, focus); stroke; migraine' (http://www.york-biofeedback.co.uk/neurofeedback/tdcs.aspx.

This use of tDCS by untrained consumers has raised risk and safety concerns associated with the intentional or unintentional misuse of tDCS devices, particularly if suboptimal tDCS devices are being used, or devices are being used incorrectly. But, even if used correctly, there is a risk of undesirable changes to the user's brain and its functioning (Fitz and Reiner, 2013). Moreover, the electrodes must be positioned correctly on the correct region in order to produce reliable effects (Brunoni et al., 2012), meaning that devices must be constructed so that the user is easily able to position the electrodes properly. Devices that enable the polarity of the stimulation to be reversed pose even more risks since reversing the polarity of the electrodes may, not only render the device ineffective in producing enhancement, but also result in impaired neuronal function. Also, stimulation that is too strong or that exceeds the optimum duration may be damaging (Maslen et al., 2014). Although the effect scope of enhancement from tDCS appears to be modest, several studies report more sizable effects (e.g. Chi and Snyder, 2011) and some observers see it as a promising option for improving human experience in a number of domains, including mathematical skills (Knechtel et al., 2013; Cohen Kadosh et al., 2010) and memory capacity (Hoy et al., 2013). Snowball et al. (2013) found that a related technique, transcranial random noise stimulation (TRNS), can induce long-term enhancement of cognitive and brain functions. Not surprisingly, there remains skepticism, with some critics calling tDCS a fad – simply the latest in a long series of 'neuro-myths' that arise when scientists distort or embellish research findings (Anderson, 2012).

While all current evidence suggests that tDCS is safe and that adverse effects are commonly mild and transient, not much is known about the chronic effects of either magnetic or electrical brain stimulation or the effect of multiple sessions (Hamilton et al., 2011). In addition, Sarkar, Dowker and Cohen Kadosh (2014) warn that the surge in non-invasive brain stimulation studies investigating CE has neglected the effect of inter-individual differences, such as traits, on stimulation outcomes and found that identical tDCS experiences can exert opposite behavioral and

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physiological effects depending on individual trait levels. Thus, brain stimulation clearly does not produce uniform benefits, even if applied in the same configuration during the same tasks, but may interact with traits to produce markedly opposed outcomes. Davis and van Koningsbruggen (2013) argue that referring to TMS and tDCS as 'non-invasive' is inappropriate, because it minimalizes the possibility of side-effects and longer-term effects of the stimulation and may thus create an illusion of comfort in participants' and non-experts' minds that is not warranted. More importantly, the established tendency for the effects of TMS and tDCS to spread from the targeted brain area to neighboring areas is contrary to the definition of non-invasiveness. They do not suggest that recruitment efforts should be forced to advertise 'invasive brain stimulation' but rather that TMS and tDCS be referred to simply as 'brain stimulation' without the potentially misleading qualifier of 'non-invasive.'

Among the most dramatic putative CEs on the horizon are brain-machine interfaces (BMIs). Although most BMIs are currently in the research stages, increased applications are expected soon and, inevitably, could enable future humans to use various kinds of brain-machine interfaces, such as neural implants to experience new kinds of virtual realities (Zehr, 2015). Development is progressing rapidly: both on the hardware side, where multi-electrode recordings from more than 300 electrodes permanently implanted in the brain have been used; and on the software side, with computers programed to interpret the signals and commands. Experiments on humans have shown that it is possible for severely paralyzed patients to control a computer cursor using just a single electrode implanted in the brain. Experiments in localized chemical release from implanted chips also suggest the possibility of using neural growth factors to promote patterned local growth and interfacing (Bostrom and Sandberg, 2009). Hildt (2010) points out that the use of brain implants or brain-computer interfaces challenge our notions of human nature and of how far human functions can be substituted for or enhanced by technical devices. Similarly, Robert (2005) argues that, while self-improvement is a noble aim, there is a dramatic and morally important difference between self-improvement through drugs and neural implants, and other forms of enhancement. However, at this early stage any enhancement applications are highly conjectural at best. Furthermore, despite advances in BMIs there are many technical problems. Patients have to submit to brain surgery in order to have electrodes connected to neural tissue, which raises the possibility of infection or other complications (Saniotis, 2009). Moreover, EEG transfer information is now

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relatively slow at about 20–30 bits/minute; thus, present technology can only record a small number of neurons, although this is likely to change in the coming decades.

Current BMIs include auditory brainstem implants, visual prostheses and an artificial hippocampus. The ultimate aim of the latter is to create a chip which would be placed on the skull of a patient who has suffered hippocampal damage due to stroke, dementia, epilepsy, or psychopathology, which could communicate with the brain via two electrode arrays, located on either side of the damaged hippocampal area (Kurzweil, 2005). Moreover, there is enthusiasm about the role of nanotechnology in future developments of BMIs, where carbon-based nanobuts would be incorporated into brain tissue, allowing their movement into neural tissue with minimal brain intrusiveness (Kurzweil, 2005). Developments in BMIs will likely comprise two research phases; the current phase consists of therapeutically based BMIs for disabled persons, and in the second BMIs will be developed to enhance cognitive and motor skills in healthy humans (Foster, 2006). Gilbert (2013) examines the emerging ethical challenges raised by implementation of nanotechnology in brain devices for CE in subjects with healthy brains.

According to Wolbring et al. (2013a), social robotics is a rapidly growing field, which offers innovative and ever-more complicated technologies for use within a range of sectors including education, healthcare and service. The technology involves the interaction of human thought with an external device (e.g. robot, robotic limb, smart wheelchair, communication device), which translates and executes an action of the user's intent. This could be effected through either surgical or non-surgical procedures. In addition to being used by disabled people to regain species-typical functions, it also could give them beyond species-typical abilities (therapeutic enhancement). BMI could also be used by healthy individuals to gain the beyond species-typical abilities (non-therapeutic enhancement), according to Wolbring et al. (2013a). At some stage, technological augmentation of so-called normal human function moves us away from the functional limitations of our species and closer to super-, post-human functions, as envisioned by transhumanists (see Chapter 2). Eventually, it is possible that we will also have applications of stem cell technologies to augment the normal range of human brain function (Zehr, 2015). As the convergence of stem cell technology and BMI continues, Zehr (2015) contends this sets the stage for real life artificial-human brain hybrids and increased applications to enhance and augment innate function, rather than simply recover lost function. This includes the extension of the concept of brain augmentation to include

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the 'global brain' (Kyriazis, 2015). Although BMIs and these more exotic possibilities are interesting, and raise significant political issues, they are not discussed further in this book.

The military and CE

The intersection of the cognitive sciences and national security raises many ethical, policy and practical concerns. The Defense Department has invested heavily in neuroscience, including basic research support to academia. DARPA's program on preventing sleep deprivation, for example, has invested millions of dollars in developing drugs that aim to prevent the harmful effects of sleep deprivation and increase soldiers' ability to function more safely and effectively after the prolonged wakefulness inherent in military operations. Interest in this program kindled further research in performance-enhancing drugs that counter sleep deprivation, such as Ampakine CX717, which enhances attention span and alertness by binding to AMPA-type glutamate receptors in the brain, boosting the activity of the neurotransmitter glutamate and other improvements on modafinil (Huang and Kosal, 2008). Other potential military neuropharmaceutical applications include improving memory retention and treating posttraumatic stress disorder. In addition to new drugs, or new uses for existing drugs, research is funded to discover new pathways for drug delivery. For instance, nanotechnologies might allow the delivery of drugs across the blood-brain barrier in ways not now possible (Lupia, 2011).

As noted earlier, DARPA has also been a primary funder of research on tDCS, with the hope that it could be used to sharpen soldiers' minds on the battlefield (Fox, 2011). Performance Augmentation through Cognitive Enhancement (PACE) was developed under the auspices of the DARPA program Improving Warfighter Information under Stress. The goal of this program is to optimize performance of combat command and control operators by using neuro-physiological sensors to control the behavior of human–computer interfaces, for example, by tailoring information presentation and task assignments to best suit the currently available cognitive resources of operators. According to Moreno (2008), governments have historically introduced performance-enhancing drugs to soldiers based on little evidence of their efficacy, compared to the trade-offs, such as artificially extended wakefulness versus impaired judgment and reflexes. A larger political and social question is how much enhancement future soldiers can legitimately be expected to accept as part of their preparation for service,

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especially since the long-term effects of these drugs might not be known until well into the future (Moreno, 2008; Morizio et al., 2005). Department of Defense research into artificial intelligence was also crucial in spurring early interest in BMIs (Huang and Kosal, 2008). This research is of interest to defense and security programs because the ability to control a machine directly with a human mind could enable the remote operation of a robot or unmanned vehicle in a dangerous or hostile environment (Huang, 2003). Such a capability would provide a substantial offensive advantage to armed forces.

Prevalence of Cognitive Enhancement

It is not easy to estimate the prevalence of CE, despite largely anecdotal 'evidence' of 'widespread use'. As Brukamp (2013) notes, at present pharmacological neuroenhancement is widely debated, but only scarce empirical data exist regarding its actual prevalence. There has been no national survey on CE drugs or brain stimulation use, and information on use is fragmented and largely limited to convenience samples, primarily of student populations. Moreover, it is likely that some respondents might be reluctant to admit using prescription medications for non-medical reasons, especially prescription stimulants, which are FDA Schedule II controlled substances. Whether involving drugs or devices, the prevalence of CE will undoubtedly differ sharply according to age, gender, occupation, geographic region and other demographic variables, complicating the task of assessing prevalence (Farah et al., 2014) and making any generalizations from small samples dangerous.

Academic researchers have examined the prevalence of CE with prescription stimulants among students and found widely varying rates of reported use. The largest and best-designed survey of stimulant use by American undergraduates was undertaken in 2001 with a sample of 10,904 students from 119 different colleges and universities (McCabe et al., 2005). It is estimated that, among American college students, 6.9 percent had used prescription stimulants non-medically in their lifetime, 4.1 percent in the past year. It also found much variation in the prevalence of this practice across the U.S. at different categories of schools and among different types of students (Smith and Farah, 2011; Szalavitz, 2009). The highest rates were found at competitive, North-eastern

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institutions, among sorority/fraternity members, and more likely males with grade point averages of B or lower.

Overall, non-medical use of prescription stimulants has been found to range from five to 35 percent in other surveys of North American young adult and adolescent populations (Wilens et al., 2008). However, the high rates reported in some of these studies are misleading because they did not distinguish between use for CE or recreation. The more likely rates for non-medical use of stimulants, specifically to improve academic performance, ranges from three to 11 percent, though a recent study using the Randomized Response Technique (RRT) showed prevalence rates of 20 percent for the use of prescription and illicit drugs among university students for CE (Dietz et al., 2013). Similar rates of prescription use have recently been reported in a *Nature*-sponsored self-selecting, non-random survey of readers where 20 percent reported having used drugs non-medically to improve concentration, focus and memory (Maher, 2008). Similarly, *Wired Magazine* asked readers to write in to share their cognitive enhancing regimens, and received 50 reports of scientists, college students and entrepreneurs' use of drugs for CE (Madrigal, 2008).

In addition to these scattered studies with students, there have been several studies of medical personnel. Surgeons, in particular, are exposed to high workloads, leading to fatigue, distress, concentration deficits, burnout or symptoms of depression. These not only increase the likelihood of mistakes during surgery, but also put pressure on them to use drugs to counteract the problems. They, of course, also have greater access to drugs. In their study based on surveys of physicians at medical conventions, Franke et al. (2013) found that 8.9 percent of all surveyed surgeons confessed to having used a prescription or illicit drug exclusively for CE at least once during their lifetime. Overall, other studies indicate that between 15 to 20 percent of surgeons have used drugs for cognitive or mood enhancement at least once. Warren et al. (2009) outlined the reasons surgeons may, in the near future, consider using CE and addressed the resulting significant ethical implications of this. The reasons included high workload and perceived work-related and private stress. Emanuel et al. (2013) conducted a survey of actively enrolled medical students at four private and public medical schools in the greater Chicago area. Overall, 18 percent of this medical student sample had used prescription psychostimulants at least once in their lifetime, with first use most often in college. They conclude that the use of psychostimulants, including without a prescription, is common among medical students and that this portends higher rates of use in future physicians (Emanuel et al., 2013).

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Indirect evidence of an increase in CE use can be found in the two- to five-fold increase in the prevalence of prescriptions for MPH in the U.S between 1990 and 1999 (Emanuel et al., 2013). One study reported that the number of healthy individuals using prescription drugs for CE purposes was larger than the number of medical users for ADHD among undergraduate university students (McCabe et al., 2006). Given this rate of illicit use, it is not surprising that access to psychostimulants among healthy populations is frequently through off-market sources. In their study of college students' attitudes on sports doping and cognitive enhancing, Partridge et al. (2011), however, found little support of media claims that the use of prescription drugs for CE is widespread among students. Only 7 percent agreed that CE is acceptable and only 2.4 percent said they had taken prescription drugs to enhance their concentration or alertness in the absence of a diagnosed disorder, while 8 percent indicated they knew someone who had done so. Interestingly, participants who found CE acceptable were 9.5 times more likely to agree with the legalized doping of athletes.

Even less is known about global patterns of CE, but it appears that North American students are more likely to use prescription stimulants for enhancement than students from several other countries surveyed, although the small convenience samples used in most of these studies precludes firm conclusions (Franke et al., 2011; Partridge, 2013; Ragan et al., 2013). Maier and Schaub (2015) conclude that CE is not yet as widespread among students in Europe as in the U.S., but that monitoring the development of neuroenhancers and individuals' willingness to use them is essential to provide effective preventative measures (Maier et al., 2013; Dubljevic et al., 2014). A study of German high school students (Franke, Lieb and Hildt, 2012) revealed lifetime prevalence rates of 0.8 percent for prescription stimulants and 2.9 percent for illicit stimulants (amphetamines, cocaine, ecstasy) exclusively for CE purposes. In an online survey of students at the University of Zurich, Ott and Biller-Andorno (2014) found that 4.7 percent of the respondents reported having used enhancement drugs, mainly Ritalin, for study purposes. Another online panel study used multiple metrics to assess the prevalence of the non-medical use of prescription medication for enhancing cognitive performance among German university students (Sattler and Wiegel, 2013). They found that the higher the cognitive test anxiety, the higher the use was during the previous six months. More worry, more drugs it seems. In contrast, Castaldi et al. (2012) concludes that the share of Northern Italian University students who have taken CE

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medication is approximately 16 percent and that the use of these drugs is rather common and freely communicated in certain social circles.

In order to provide comparative data on the substances, prevalence rates and factors associated with CE in Germany, Franke et al. (2011) first assessed data about the use of coffee, caffeinated drinks and caffeine tablets for CE at school and university. They found that lifetime, past-year, and past-month prevalence for the use of coffee for CE was 53.2, 8.5, and 6.3 percent, caffeinated drinks 39.0, 10.7, and 6.3 percent, and caffeine tablets 10.5, 3.8, and 0.8 percent. In a follow-up study, Franke, Lieb and Hildt (2012) interviewed a sample of 18 healthy university students who had reported non-medical use of caffeine as well as illicit/prescription stimulants for the purpose of CE. Forty-four percent answered that there is a general difference between the use of caffeine and illicit/prescription stimulants for CE, 28 percent did not differentiate and 28 percent could not decide. Furthermore, 39 percent felt that there is a moral difference between them while 56 percent said there is no moral difference. Importantly, they found that participants were well informed with regard to medical law and that illegality of stimulant use tended to serve as a decisive argument that ends any further discussion for most students. The fact that illegality was so important in the users' evaluation of CE suggests that liberalization of the law would lead many students to assume that there are no further relevant ethical issues with regard to CE.

Partridge (2013) contends that, overall, the evidence for the prevalence of non-medical stimulant use by students for CE has a number of weaknesses. He cites examples where the prevalence of CE has been uncritically presented and argues that caution needs to be exercised to avoid stirring up hype about CE by overextending what the currently available, and very limited, data on prevalence really reveals. As noted by Forlini et al. (2013), however, prevalence is a measure of the distribution of a practice, but not of the greater desire for such drugs. Furthermore, it is problematic to assume that public demand for cognitive enhancers is the same as a demand for research on the efficacy of cognitive enhancers. Demand is often equated to prevalence, but this equation is at best an approximation and, at worst, misleading.

Does Cognitive Enhancement work?

A basic question for each potential CE technique is how well it works. From the short comments above about each drug, it is obvious that, at

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best, evidence is mixed. Based on a systematic review and meta-analysis, Repantis and colleagues (2010) showed that expectations regarding the effectiveness of most CE drugs exceed their actual effects. According to these data, it seems that the strongest reason not to use prescription drugs for enhancement purposes at this time is the lack of evidence both for their effectiveness and their long-term safety in healthy people. For MPH, an improvement in memory was found, but no consistent evidence for other enhancing effects was uncovered. Modafinil, on the other hand, was found to improve attention for well-rested individuals while maintaining wakefulness, memory and executive functions to a significantly higher degree in sleep-deprived individuals than a placebo did. However, repeated doses of modafinil were unable to prevent deterioration of cognitive performance over a longer period of sleep deprivation, while maintaining wakefulness and possibly even inducing overconfidence in a person's own cognitive performance. Similar findings emerged from a review of more than 50 experiments on the effects of amphetamine and methylphenidate by Farah et al. (2014) who found convincing evidence of an enhancing effect of stimulants on learning under some circumstances, specifically when the retention interval between study and test was longer than an hour, but not at shorter intervals. They also concluded that the evidence for improvement of executive functions was much less clear. In another study, Ilieva, Boland and Farah (2013) examined the effects of amphetamine on 13 different measures of cognitive performance using a design with power sufficient to detect a medium-size effect in any one measure and failed to find any evidence of reliable enhancement. Interestingly, despite this study participants tended to believe their performance was enhanced when on the drug relative to the placebo.

Twenty-seven CE agents were identified in the Foresight report, 'Drugs Futures 2025?' (Nagel, 2010). Of these, ten were dietary supplements and most of the remainder were pharmaceuticals that work by enhancing (or diminishing) transmission across certain synapses. They found that evidence of effectiveness is still relatively limited, even less so for dietary supplements. The relationship between the performance of synapses, the use of drugs to boost their activity and any resulting cognitive benefit remains uncertain. The evidence of benefit in healthy users is slimmer still, but despite this, the availability of drugs bought via the Internet encourages the curious and the hopeful to buy them. In addition, doses of otherwise effective drugs which are too high or too low may both lead

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to a drop-off in synapse performance and, thus, in cognitive function. Moreover, there may be different optimum doses for different functions implying that it might not be possible to maximize performance in all types of brain function at the same time (Nagel, 2010).

For instance, in people without ADHD, the intellectual impact of stimulants remains unimpressive. In a 2012 study of the effects of Adderall on people without ADHD, psychologists found no consistent improvement on numerous measures of cognition, even though, again, people taking the medication believed that their performance had been enhanced (Sharpe, 2014). In spite of this, ADHD diagnoses are rising rapidly around the world and especially in the U.S., where 11 percent of children aged between four and 17 years old have been diagnosed with the disorder. Between half and two-thirds of those are put on medication, a decision often influenced by a child's difficulties at school. Although stimulant medication has gained a reputation for turbo-charging the intellect, even for most people with ADHD, these remedies might quickly calm users down, and increase their ability to concentrate, but a growing body of evidence from longer-term studies suggests that the benefits largely end there (Sharpe, 2014). Studies indicate that even for those diagnosed with ADHD, the improvements do not translate into better academic achievement or even social adjustment in the long term: people who were medicated as children show no improvements in antisocial behavior, substance abuse or arrest rates later in life. And one recent study suggested that the medication could even harm some children (Currie et al., 2014).

Moreover, as de Jongh and colleagues (2008) note, there are a number of caveats in the development and use of neuroenhancers. First, according to the inverse U-function principle, enhancement is possible only as long as we do not already have an optimal level of arousal, vigilance or neurotransmitter concentration. Thus, an already optimally tuned brain can hardly be enhanced and, given that usually our brains already perform near the best of their ability, enhancement for most people seems limited (Quednow, 2010; Husain and Mehta, 2011; Sahakian and Morein-Zamir, 2007). To date, cognitive effects in well-rested healthy subjects have been small and hard to detect (Kumar, 2008). Interestingly, those who have the least ability in a particular area are likely to see the greatest drug-related improvement. In fact, on some tests of cognition, the smartest people actually showed performance reductions, thus stimulants had a leveling effect, allowing below-average performers to catch up to their peers, not dominate them (Szalavitz, 2009). According

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to Maslen, Faulmüller and Savulescu (2014b) this fact is important in the cheating debate (see Chapter 2) because it means that low performing individuals will tend to be on the upward slope of the inverted-U and can benefit from a substance that moves them further up this slope while high performing individuals tend to be at the peak of the inverted U and will, therefore, become impaired by a substance that further increases neuro-transmitter levels. Thus, individuals with a 'low memory span' might benefit from cognition-enhancing drugs, whereas 'high span subjects' might become 'overdosed.' At best, therefore, even if a technique proves to be an effective enhancer, it will not work for everyone.

A second caveat is whether, when we enhance one cognitive function, we end up reducing others. If so, doses most effective in facilitating one behavior could simultaneously exert null or even detrimental effects on other cognitive domains. Davis (2014) points out that no brain region exists in isolation. Therefore, we could enhance our working memory, but, concurrently, decrease our long-term memory, or vice versa, but we cannot enhance both simultaneously. Or, increases in cognitive stability might come at the cost of decreased capacity to flexibly alter behavior (de Jongh et al., 2008). While early research into brain stimulation in healthy adults has focused on its potential to enhance cognitive functions, the cognitive costs that might be associated with such enhancement largely have been neglected, particularly since it has been shown that enhancing cognitive performance on one task can be associated with detrimental performance on a different cognitive task (Iuculano and Cohen Kadosh, 2013; Sarkar et al., 2014).

Enhancement, then, is likely to involve trade-offs, implying that some sort of sacrifice in one domain is the cost of enhancing another. As stated by Maslen, Faulmüller and Savulescu: 'We might conceive of an individual who chooses to enhance his or her working memory such that he or she can solve complicated puzzles quickly. This same individual might accept that this enhancement comes at the cost of him or her finding it harder to recall facts and experiences from longer ago. Accordingly, whilst the physical act of ingesting a substance might be easy, there is a sense in which the enhanced capacity did not come easily – it did not come without personal cost' (2014: 9–10). When coupled with the likelihood of long lasting effects on the brain (Snowball et al., 2013), a situation arises in which parents might inadvertently or even knowingly limit some future options of their children when they choose to enhance particular capacities at the expense of others.

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Brem et al. (2014) suggest a variety of mechanisms by which transcranial stimulation could affect cognitive function, including changes in the distribution and/or amplitude of processing power, reduction of neuronal interference processes, and/or changes in how fast processing power can be re-distributed. They propose a 'net zero-sum model', based on the principle of conservation of energy in closed systems. This raises questions if it is acceptable, or wise, to improve certain brain functions at the cost of others. Also, can we take the responsibility for its impact on the individual and on society? Current CE studies emphasize positive outcomes of specific functions and concentrate on individual improvements, while related topics – such as risk, safety and assessment of cost, as well as social and moral factors – are neglected or restricted to specific inquiries. To support their case, they use examples of brain stimulation and brain lesion studies that have found enhancement of one area of cognition concurrent with lessening of another. They argue that it is imperative to emphasize the estimation of enhancement benefit versus cost and that the net-zero sum concepts may be helpful for guiding future studies by proving an estimate of the cost–benefit ratio (Brem et al., 2014).

Iuculano and Cohen Kadosh (2013) attempted to rectify the tendency of most CE studies to focus on optimizing protocols for effective stimulation and assessing potential physical side effects while neglecting the possibility of cognitive side effects by targeting the high-level cognitive abilities of learning and automaticity in the mathematical domain, two critical abilities for potential CE. Stimulation to the posterior parietal cortex facilitated numerical learning, whereas automaticity for the learned material was impaired. By contrast, stimulation to the dorsolateral prefrontal cortex impaired the learning process, whereas automaticity for the learned material was enhanced. The observed double dissociation indicates that CE through TES can occur at the expense of other cognitive functions. Their results demonstrate that enhancement of a specific cognitive ability can happen at the expense of another ability, thus supporting the zero-sum theory.

According to Luber (2014), however, the zero sum framework is simply wrong: enhancements in the brain do not always represent a re-allotment of finite resources with the gains in one function balanced by depletions elsewhere. In no literal sense can the brain be considered a closed system. Luber found that about half of reports of brain enhancements may have been the result of resource reallocation, but the other half of

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reports suggest that brain stimulation can cause an addition of available resources. He suggests that while it is important to examine whether costs occur with brain stimulation, a more helpful framework from which to understand CE is to understand brains as systems designed to continuously enhance their own functions and available resources, through learning, automatizing useful behavior and so forth, and view CE as a means to augment these ongoing processes. Although one should look at adverse side effects as well as potential gains (Davis et al., 2013), the great promise for CE lies in more permanent improvements, whether in remediating deficits in neurological or psychiatric patients or in enhancing the skills of healthy individuals. It is in this sense that using a zero-sum framework in the context of CE is not appropriate (Luber, 2014).

Farah et al. (2014) also raise questions about the research to date and find it wanting. Given the small sample size of just several dozen subjects or fewer in most of the relevant studies and the likelihood of publication bias against null results, 'it is difficult to draw definite conclusions concerning the cognitive enhancing effects of either the drugs or stimulation methods.' While a number of positive results make it appear that cognition can be enhanced in the laboratory with drugs and non-invasive brain stimulations, it is difficult to ascertain the actual scope and generality of these effects. Furthermore, no studies have assessed the carryover from effects of tests in the laboratory to effects in the real-world normal healthy subjects.

> On the one hand, small effects might only show themselves in the carefully controlled context of laboratory study. Such effects might become imperceptible in real-world work situations. On the other hand, an effect that is small when measured in a single experimental session in the lab may compound itself in ongoing work situations and ultimately yield substantial benefits for the enhancement user. Without the necessary empirical research it is impossible to know how the cognitive enhancers reviewed here might impact real-world users. (Farah et al., 2014: 100)

Even more emphatically, Quednow (2010) disputes the pharmacological premises of the entire CE endeavor. He contends that the kind of substances presumed by many claims to make us significantly smarter without serious adverse effects do not exist, and will not exist in the foreseeable future. None of the drugs tested so far has shown replicable and significant effects in healthy human volunteers (de Jongh et al., 2008).

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Quednow (2010) contends that many ethicists have been led astray by the exaggerated promises of neuroscientists who are either collaborators of the pharmaceutical industry or forced to overstate their own results to get increasingly competitive research funding. 'As a matter of fact, we are currently even unable to fully restore disturbed intellectual functioning in psychiatric or neurological diseases and we still do not know how to achieve this goal in the future' (Quednow, 2010: 153). Furthermore, he reiterates that, because of the complexity of the brain, it is unlikely that we will be able to overcome trade-offs between simultaneous enhancement and impairment by drugs. In addition to the collateral adverse effects on cognitive functions of these drugs, the available substances have many psychiatric and somatic side effects that make them not well suited for use in healthy humans for the purpose of enhancement (Quednow, 2010). While Nadler and Reiner (2010) sympathize with Quednow and others that the current crop of so-called cognitive enhancers appear not to be so effective as to raise substantive ethical concerns, they do not share his certainty that neuroscience will never be able to produce psychopharmacological cognitive enhancers.

In their recent review, Ragan et al. (2013) note that modafinil was reviewed by the European Medicines Agency (2010), which concluded that it should not be prescribed for obstructive sleep apnea, shift-work sleep disorder and idiopathic hypersomnia because of the risks of serious skin reaction, suicidality, depression, psychosis, and adverse cardiovascular events. Another type of risk that cannot be ignored in a consideration of the safety of potential CEs is that dependence. A nationwide survey analyzed by Kroutil et al. (2006) estimates that almost one out of 20 non-medical users of prescription stimulants meet the criteria for dependence or abuse (Outram, 2010). As noted by Ragan et al. (2013), we must remember that there is no such thing as a completely safe drug, only a drug whose benefits might outweigh its drawbacks. However, as Kantak and Wettstein (2015) argue, one must consider the possibility that no single drug or technology will have a great impact on cognition and, therefore, combination therapy of drugs plus other approaches like exercise or tDCS may be the path forward.

In summary, despite the huge interest in CE, the evidence of effectiveness is still inconclusive. Moreover, where there is evidence of enhancement effects, they often tend to be limited to improvements on specific tasks and are only evidenced at certain dosages and in some people (Ragan et al., 2013; Farah et al., 2014). Crucially, it must be remembered that the degree and nature of any cognitive improvement will be different for each CE and so no

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sweeping claims should be made about the effectiveness of CEs in general. Moreover, in terms of both effectiveness and safety, it should also be noted that short-term studies carried out in laboratory settings are not representative of long-term use in real world contexts (Maslen, Faulmüller and Savulescu, 2014b). Since their use can lead to safety risks and can cause severe side effects, a general use by healthy persons cannot be justified, according to Franke et al. (2013). But the point for public policy is that they are being used despite the lack of scientific evidence.

Trachtman (2005), however, dismisses the argument that there will be a huge demand for CE. Although each advance reported in the press might be greeted by the public with great fanfare, in reality, many treatments are rejected by large segments of the population (see Chapter 2). 'There will always be people in search for the quick fix to treat obesity, prevent dementia, or win an Olympic medal but it is contrary to experience to think that everyone will line up for each new enhancement opportunity' (Trachtman, 2005: 32). Lucke et al. (2010) agree that estimates of the rising prevalence of CE have been exaggerated. Moreover, while Nadler and Reiner (2010) are also skeptical that any warranted conclusions can be drawn about the presence or absence of an 'epidemic' of CE and feel that the controversy over CE has largely generated more heat than light. They notes that the most responsible pronouncement on this topic remains 'we don't know.' They go on to argue, however, that more data is needed to actually understand what the population really thinks about CE, thus inviting broadened discussion and deliberation. 'Even if cognitive enhancement never materializes in the form envisioned by its most enthusiastic boosters, we view data-driven discussion as salutary because the topic is ultimately an implement that helps us dig at subtler ethical issues arising at the interface between science and society' (Nadler and Reiner, 2010: 481). Chapter 2 turns to a discussion of the ethical issues and social context that frame the broader public policy discussion in the Chapters 3 and 4, which address Nadler and Reiner's call for more research.

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2
Ethical and Social Context of Cognitive Enhancement

Abstract: *This chapter discusses the emerging debate over CE that includes potential safety problems with the long-term use of drugs in healthy individuals, the possibility of direct or indirect coercion to take enhancement drugs, the social justice concerns that access will not be distributed equally and that the use of enhancement poses a threat to social values by undermining the worth and dignity of hard work and represents a form of cheating. In general, the concerns of the critics can be classified into two broad categories: concerns about the harm that may be experienced by those who use the enhancement technologies and concerns about the adverse social impact of the widespread use and societal embrace of enhancement technologies. The chapter also looks at public opinion toward CE and the impact of the media, the Internet and commercialization on CE.*

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Before examining the policy implications and politics of CE, it is important to review the underlying ethical and social concerns that dictate the need for some level of political involvement. To this end, Racine and Forlini (2008) introduce three competing paradigms of CE that can help us better understand the current debate: prescription drug abuse, cognitive enhancement; and lifestyle use of pharmaceuticals. The prescription drug abuse paradigm is most common in public health (as well as many scientific) studies which express concerns for the health of individuals engaging in these practices and highlight the health risks and potential for dependence associated with the non-medical use of these drugs. By contrast, the term prescription drug abuse is rarely encountered in the bioethics literature where the non-medical use of pharmaceuticals is referred to as cognitive or performance enhancement. Instead of addressing the public health risks of long-term non-medical use of drugs, this paradigm emphasizes the potential impact on the individual by addressing issues related to identity and personhood, autonomy, fairness and where enhancement fits within the purview of medicine. In part reflecting largely enthusiastic portrayals of CE, the bioethics community, therefore, contrasts with the more critical public health perspectives.

The lifestyle paradigm is employed by primarily the media where personal choice transforms prescription drugs into lifestyle drugs to be used as study aids or smart drugs: CE simply reflects the individual choices of citizens living in liberal democratic societies marked by medical consumerism. Although this paradigm reflects an escalating acceptance of CE among some of the public and is reinforced by the media and commercial interests, according to Racine and Forlini (2008), it risks assuming that CE is a safe and acceptable practice in spite of many unknown risks. This paradigm is the most challenging for the medical and bioethics communities because its view of the role of drugs for self-achievement deviates from the common understanding of pharmaceuticals as treatment prescribed for illness.

Racine and Forlini (2008) correctly argue that while these paradigms demonstrate a lack of consensus on the acceptability of CE, paying attention to diverging paradigms can help identify some important 'ethics blind spots'. On the one hand, describing non-medical prescription use favorably as 'enhancement' or a 'lifestyle choice' may lead to the proliferation of non-medically approved practices based on misconceptions. As described later in this chapter, the media has tended to use sensationalist language to describe CE while bioethics scholarship, in general,

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has optimistically labeled the practice enhancement without clear scientific evidence. On the other hand, not recognizing the mounting public enthusiasm for CE use could diminish public health interventions that neglect the social acceptance of CE found in the enhancement and lifestyle paradigms. What might be viewed as problematic from a public health perspective, then, may have already become legitimized in the public domain. Out of these three perspectives, a debate over CE emerged, simmered and expanded over the last decade.

The evolving debate over Cognitive Enhancement

Some libertarians argue that cognition-enhancing drugs should be widely available to anyone who wants them, thus requiring a radical revision of current drug policies that prohibit off-label use beyond their prescription-only status (Capps, 2011). Among the most extreme proponents of CE are transhumanists (Reiner, 2013). Transhumanism is the loosely defined intellectual and cultural movement that affirms the possibility and desirability of fundamentally improving the human condition through applied reason, especially by developing and making widely available technologies to eliminate aging and to advance human intellectual, physical and psychological capacities (Bailey, 2005; Young, 2006). According to Bostrom, the transhumanist vision is to 'create the opportunity to live much longer and healthier lives, to enhance our memory and other intellectual faculties, to refine our emotional experiences and increase our subjective sense of well-being, and generally to achieve a greater degree of control over our own lives' (2003: 493). Ashcroft and Gui (2005) add that this conception of enhancement technologies is all about the extent to which we can correctly consider the human body and individuals' personalities themselves as machines that can be broken down or repaired, and that can be considered as designed and improved through redesign.

Transhumanists look forward to post-human descendants – beings whose basic capacities so radically exceed those of present humans as to be no longer unambiguously human by current standards – who may be resistant to disease, have unlimited youth and vigor, reach intellectual heights above any current human genius, have increased capacity for pleasure, love, and artistic appreciation, and experience novel states of consciousness that current human brains cannot achieve (Agar, 2007).

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To this end, they favor modifications that produce longer active life spans, better memory, greater intellectual capacities and the increased ability to make subsequent choices wisely. CE is but one small part of the transformations they support. They predict that parents who are free to enhance their children's intellects, physical constitutions and life expectancies will choose to do so (Agar, 2007). Furthermore, if there are basic enhancements that would be beneficial for a child, but that some parents cannot afford, then society should subsidize them, just as it does with basic education (Bostrom, 2003). Ironically, by their unabashed extreme acceptance of enhancement, transhumanists have given fodder to the opponents of enhancement.

On the opposite extreme from the transhumanists are the bio-conservatives. Reiner (2013) contends that the publication of *Beyond Therapy* by the President's Council on Bioethics led by bioethicist Leon Kass framed the debate on CE for a decade (Kass, 2003). The position adopted by the Council, embedded in an appeal to naturalness and founded on religious precepts, condemned CE as an affront to human dignity. If God wanted us to be enhanced we would already be so, thus any attempt to develop enhancements is an affront to the wisdom of the Creator. This bio-conservative view soon found itself in alliance with environmentally sensitive cultural critics who held that CE is just another symptom of the modern world's estrangement from Nature, another example of how disconnected we have become from our 'humanity' (McKibben, 2003). Moreover, others argued that:

> The use of CE could have profound and unpredictable consequences for society because it could allow people to create cognitive structures of a type that do not occur within the range of normal human experience. The possibility of drugs that *add* cognitive capabilities brings with it an additional set of social impact questions. The sudden appearance of new abilities would likely have profound and quite possibly irreversible effects on society. (Lynch, Palmer and Gall, 2011)

As has happened with the more radical adherents, however, the thrust of recent criticism has shifted to less impassioned and more practical problems with CE (Outram, 2012). Much of the criticism today is focused on the potential safety problems of the long-term use of CE techniques, the possibility of direct or indirect coercion to use enhancement drugs, the argument that access to enhancement technologies is likely to be expensive and not available equally, and, that at its core, the use of enhancement poses a threat to social values by undermining the worth

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and dignity of hard work (Ashcroft and Gui, 2005). Often, this opposition is framed in terms of a slippery slope argument (see Launis, 2010). In general, then, the concerns of the skeptics can be classified into two broad categories: concerns about the harm that may be experienced by individuals who use the enhancement technologies and concerns about the adverse social impact of the widespread use and societal embrace of them (Hall et al., 2004; de Jongh et al., 2008; Illes and Bird, 2006).

Although there are potential adverse reactions to all therapeutic drugs, these injuries are usually outweighed by the relief afforded from the symptoms of the disease. However, when given to disease-free individuals, the trade-off between the harmful effects with the more uncertain benefits of enhancement is blurred. As introduced in Chapter 1, there is a fear that, while access to cognitive enhancers might be desirable in theory, they could have adverse medical consequences (Flaskerud, 2010). Prozac, for example, was supposed to make miserable lives tolerable and tolerable lives wonderful, but reality is not that simple. The actual impact of the drug is less predictable and could lead to personality changes instead of the intended mood improvements (Häyry, 2010). Critics also warn that many of these drugs have not been tested for off-label use and that some, such as stimulants, can be addictive or dangerous (Volkow and Swanson, 2008; Quednow, 2010).

The concerns over risks and uncertainties are especially critical when the techniques are used in non-clinical, especially commercial, settings. According to Goldberg (2007), no technology is absolutely safe, and even non-invasive procedures such as Magnetic Resonance Imaging (MRI) have some risk. Caution is particularly warranted when an intervention is irreversible but also when the short- or long-term consequences are too subtle to notice, too idiosyncratic to define, or too safely within the range of normal to be called adverse. For instance, as noted in Chapter 1, even as Deep brain stimulation (DBS) has grown as an accepted therapy, concern over its long-term effects persists (Schlaepfer, Lisanby and Pallanti, 2010). Concern deepens when the intervention involves treatment of behavioral disorders that lack a proven organic origin or the modification of questionably disordered behaviors that are troublesome principally to families, societies, governments or insurers.

Kamm (2005), too, has major problems with CE, questioning whether we could ever really safely alter people without making disastrous mistakes. He also asks why CE should be a top priority in light of scarce medical and societal resources. A deeper issue, he argues, is our lack of imagination as

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designers. Unfortunately, most people's conception of the varieties of goods is very limited, and if they redesigned people their improvements would likely conform to limited, predictable types. However, in his analysis of Kamm's position, Schwartz (2005) asks why interventions that fix biological dysfunctions should have a superior moral status to interventions that modify normal functioning, since both aim to fulfill human desires and ease suffering. Similarly, the 'exclusivity of choice, and an uncritical deployment of enhancement as an unequivocal good, underplay the role of a social and political community, and leave one unable to discriminate between, and solve, conflicting ideas of "good"' (Capps, 2011: 127).

There is also a criticism aimed at the pharmaceutical industry that creates a market for drugs and procedures by convincing people that ordinary states are syndromes that require drug treatment or by selling medication to people who are not ill. CE represents a potentially huge market, not only for drug companies but also for physicians who might enter the potentially lucrative specialty of cosmetic neurology (Larriviere and Williams, 2010). Many middle-aged people who want youthful memory powers and multitasking workers who need to keep track of numerous demands will want access to these drugs. Of course, drug companies will 'gladly have a world where everyone needs to buy their products in order to compete in school and the workforce' (Flaskerud, 2010: 63). Similarly, Coors and Hunter (2005) contend that the desire for enhancements by a public ill-equipped to understand the detail of any proposed intervention, coupled with financial incentives on the part of promoters of the technology, has the potential to lead to lead to grievous and potentially irreversible harm to many individuals.

Carrying this into the social realm, Martin and Peerzada (2005) argue that we should move with caution on enhancement because it could imply that some people have less intrinsic human worth than others. Although eliminating certain characteristics or increasing certain capacities might express nothing more than a personal preference, it could send the message that some people (the smarter ones, the stronger ones, the more competitive ones) are of greater intrinsic value than others (Shook et al., 2014). There are also additional questions about whether drugs that enhance concentration might diminish creativity, according to Farah and colleagues (2009).

Another fear about the impact of enhancement technologies is that their widespread use will raise the standards for what counts as normalcy

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and force an arms race in the use of enhancement technologies where individuals are pressured into using them as a way of 'keeping up with the Joneses.' Explicitly and implicitly the contemporary medical endorsement of interventions that restore or sustain 'normality' conforms to socio-cultural requirements that all people should seek and exhibit normal functioning, rather than what is regarded to be abnormal or anti-social conduct that deviates from socially established standards. This raises the question of what position should be taken when people seek optimal functioning in pursuit of what they personally deem to be the apex of the good life and/or society sets requirements that individuals in special roles (such as physicians, pilots, peace officers, or soldiers) must use CE to attain some level of optimal functioning (Goold and Maslen, 2014). Furthermore, it could increase discrimination against the disabled and people with medical conditions who decline to be enhanced (Parens, 2002).

Concerns are also raised about the societal implications of CE as it relates to distributive justice, that it will lead to unfair advantages for the best off. Will inequities in access to CE technologies exacerbate social inequality by adding to the advantages of elites (Wolpe, 2003)? According to Chatterjee (2007), in modern competitive societies, the social and cultural pressures to secure all the latest enhancements for one's children and oneself will always benefit the already best off. A common criticism of CE, therefore, is that the better off will have access while the poor – who might need it most – will not, thus resulting in wider disparities in society (Giordano, 2010). While there is potential for CE to aggravate unfairness if its distribution is unregulated, this is not a foregone consequence (Sandberg Savulescu and Kahane, 2011). Similarly, Cakic (2009) dismisses calls to ban CE on the grounds it might create an uneven playing field since, because of genetics or environment, there never was an even playing field to begin with. Although CE might make an already unfair playing field more unfair, 'using unequal distribution to justify the prohibition of nootropics is akin to prohibiting private tuition, which also increases academic performance while exacerbating educational inequalities between social classes. If nootropics represented the most cost-effective means of enhancing academic performance, social programs might seek to make them accessible to the underprivileged' (Cakic, 2009: 612).

Moreover, as noted in Chapter 1, there appears to be a baseline effect of much CE which means that individuals with low working-memory capacity improve while high-span individuals are either not affected, or can even

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be impaired (de Jongh et al., 2008). This means that those most in need of enhancement would benefit most from it, while brighter ones would not benefit at all, or might even experience impairment from the same substance. Given this evidence, it has been suggested that enhancement might actually serve to reduce inequality. For Bostrom and Sandberg (2009), however, this would depend on whether CE is expensive or cheap. In the end, public policy and regulations can either contribute to inequality by driving up prices, limiting access and creating black markets or reduce inequality by supporting broad development, competition and subsidized access for disadvantaged groups. Wagner (2013) agrees that, whether CE ultimately decreases or increases fairness in society depends upon broader decisions by society to level the playing field and provide equal opportunities to compete.

A similar issue surrounding CE is that it is a form of cheating: against others who do not use it; or against oneself because it does not represent natural achievement (Flaskerud, 2010). Moreover, one's self-perception could change as we become mechanistic beings, no longer able to take credit for our achievements; virtues such as motivation and working hard could become outdated (Illes and Bird, 2006). If cheating is understood as breaking the rules in order to gain an unfair advantage over others, it can be argued that some enhancements are a form of cheating. According to Schermer (2008), however, this problem is relatively easy to remedy by changing the rules instituting controls and sanctions and, therefore, should not constitute a categorical objection to enhancement. Goodman (2010) notes that an ethics of enhancement should not rest on blanket judgments, but should allow us to distinguish between the kinds of activities we want to enhance. CE should be tolerated when the activities at stake are non-zero-sum and when the importance of process is outweighed by the importance of outcome (for a discussion regarding academic misconduct, see Dubljevic et al., 2014). Forsberg (2013) concludes that none of the issues regarding responsibility raised by critics hold up under scrutiny as valid objections to the use of CE.

A related issue centers on authenticity, or the self's sense of its own uniqueness and individuality, and the desire to be true to this self (Singh 2005; Maslen et al., 2013). For instance, psychotropic drugs may diminish a 'real' self, or transform the self, if given on the assumption of a self that is identifiable, coherent and stable. This concern extends to physical interventions such as DBS (Kraemer, 2011). According to Johansson and colleagues (2011), authenticity urges us to live in accordance with

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our given nature, meaning 'that which we are' has a privileged position. Therefore, diversions from our given nature are morally problematic, particularly those that distance a person from his or her true self. Maslen et al. (2014) contend that whether CE is authentic depends on whether it helps a person to achieve her autonomous goals. For instance, if CE can help an individual to concentrate better and, thus, achieve the goals he or she values, this increases rather than undermines authenticity. Often people have a range of qualities and they could use CE to bring out some of those qualities. Furthermore, if CE merely amplifies, rather than adds entirely new qualities, then it enables the self to evolve.

Bublitz and Merkel (2009) claim that authenticity is not an adequate condition for autonomy and that, in principle, CE does not threaten autonomy. However, social relationships are built on stable and enduring conceptions of other people and they could be threatened by pharmaceutically induced changes in personality. For instance, Singh (2005) found that the dilemmas mothers face regarding their use of Ritalin for their boys on weekends revolve around dialectic of authenticity and personal freedom: Who is the real boy really? and, Can he be free to be who he really is when he must be chemically controlled in order to be free? Interestingly, while Singh found that many mothers saw their son on medication as the authentic self where he felt best about himself, other mothers refused to medicate their sons on weekends, implying that a boy's behavior is part of who he really is and to deny or restrain that part of him through medication is to subject him to a suspect medical explanatory model. This anti-therapeutic narrative sees the un-medicated boy as the authentic boy and justifies mothers withholding medication on the weekend's because they want their sons to be themselves, or to know who they really are when free from the confines of a school setting (Singh, 2005).

Another question is whether the availability of enhancers might not create professional duties for individuals in high-risk professions such as surgeons or pilots to utilize them (Maslen et al., 2015). The U.S. Air Force has already approved the use of modafinil by its pilots and some medical practitioners wonder whether enhancement might be required of them in the future (Rose and Curry, 2010; Talbot, 2009). It has also been trialed in emergency physicians, when performing non-medical-related tasks at the end of a nightshift (Warren et al., 2009). Santoni de Sio, Faulmüller and Vincent (2014) posit that, assuming a particular CE proves to be relatively safe and effective at reducing the risk of negative outcomes, by virtue of what is at stake in the performance of their professional roles, some professionals might legitimately

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be expected to cognitively enhance themselves even if they would rather not do so. They suggest that, even though this question may sound counterintuitive at present, such an expectation might be a realistic scenario in the future. First, there is already an existing and accepted practice of expecting diabetic drivers and others to take brain-invasive medication for the benefit of other drivers. Second, it makes little difference whether the medication is used to treat or to enhance, because the persons concerned are expected to take the medication, not for their own benefit but for the benefit of others.

Goold and Maslen (2014) offer a detailed legal analysis of whether surgeons who are at risk of making fatigue-related errors during patient care might be considered, at least under certain circumstances, to have a legal duty to enhance. Their conclusion is that, at present, such a legal duty cannot be imposed because of reasonable doubt about the efficacy of current enhancers and their possible negative side effects. However, they state that, in a future scenario in which efficacious and relatively safe cognitive enhancers were available, surgeons might legally be burdened with a duty to take pharmacological cognitive enhancers to reduce the risks of fatal fatigue-related error, if other, less invasive options – such as taking a nap, or being replaced by another surgeon – were not possible. As a legal question, Shaw (2013) asks whether it would ever be morally permissible to employ certain types of CE to enhance offenders' capacities for practical reasoning and moral communication as part of their rehabilitation.

Although some (Sandberg et al., 2011) argue that CE could offer significant social and economic benefits through reduction of losses, individual economic benefits and society-wide benefits, Sarewitz and Karas (2007) warn that individual decisions to pursue CE could also lead to unintended or undesirable outcomes at the group or community level when practiced by many people. No one knows what the outcome of many people simultaneously pursuing enhanced intelligence, memory or sensory acuity might be, but past experience suggests we should not expect that enhancements at the individual level will automatically aggregate into enhancements for society as a whole. Therefore, at times cognitive liberty could be in tension with the interests of broader communities to pursue desired outcomes.

A right to Cognitive Enhancement?

This latter point raises a more fundamental question of whether there is a right to enhance (Bostrom and Roache, 2009; Blitz, 2010). Bublitz (2013) contend that it is important to recognize cognitive liberty, which is a basic freedom that restricts state interference with the minds of citizens. The

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decision to enhance or to refuse to enhance one's mind is a central aspect of cognitive liberty. Thus, harm-reduction, instead of prohibition, should be the default choice with respect to CE technologies. Moreover, drawing strict dichotomies between what is valuable and what is not loses some of its persuasiveness given the thin line between therapy and enhancement (Bublitz et al., 2013). Similarly, in his extensive legal analysis of the constitutional base of CE, Blitz (2010, 2015) concludes that people are protected to some extent when they use CE to raise their healthy minds to a state they prefer. The power to reshape one's thinking processes biologically should be recognized as merely one form of a more general power that 'freedom of mind' gives us. Freedom of thought recognizes and protects CE technologies, although restrictions by the government are justified, at least for safety reasons. In summary, Blitz argues that, while freedom of thought may be close to absolute in certain situations, it is more limited when linked to action that could inflict serious injury. Similarly, Sententia (2004) argues that public policy decisions about CE should be guided by the democratic right to what she terms 'cognitive liberty' – the principle of safeguarding one's own thought processes – rather than by moralism or paternalism. Moral and safety precautions will inevitably have a place in determining appropriate use of drugs, but what is paramount is that each individual have access to the information necessary in order to determine for him or herself what is an acceptable personal risk.

Many of the most challenging dilemmas in democracies surface as governments struggle to find the proper mixture of these rights in the light of conflicting interests. Because of the heavy emphasis on rights to health care in many countries, the distinction between negative and positive rights is important (see Heywood, 2002). Negative rights are those rights that impose obligations on governments and other citizens to refrain from interfering with the rights bearer. They relate to the freedom to be left alone to use one's resources as one sees fit. Under negative rights, each person has a sphere of autonomy that others cannot violate; but no one is further obliged to take positive action to provide that person with the resources necessary to exercise that right. The only claim on others is a freedom from intrusion. CE as a negative right would allow individuals with adequate personal resources to maximize their use of CE without government interference.

By contrast, positive rights impose obligations on others, such as taxpayers, to provide those goods and services necessary for each individual to fully exercise her or his rights. Although the level of positive

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rights is generally ill defined, this additional dimension requires the presence of institutions that guarantee a certain level of material well-being, usually through governmental redistribution of resources. Positive rights imply freedom from deprivation: the entitlement to at least a decent level of human existence. The welfare state is based to a large extent on this more expansive notion of rights. Although Bostrom and Roache (2009) argue that the case for a negative right to CE – based on cognitive liberty, privacy interests and the interest of persons in protecting and developing their own minds and capacity for autonomy – seems very strong, it is less clear whether access to CE should be regarded as a positive right. Although proponents of a positive right to enhancements could argue their case on grounds of fairness or equality, this depends on whether the societal benefits of effective CE turn out to be so large and unequivocal that it would be economically efficient to subsidize enhancement for the poor, just as the state now subsidizes education. The resolution of this issue takes us into the realm of public policy and is likely to differ greatly across countries.

Physicians and Cognitive Enhancement

CE is increasingly taking place outside the medical community, on the Internet, in a quest to get legal access to prescription drugs. As a consequence, there is increasing pressure on doctors to prescribe drugs for CE; although, as noted in Chapter 1, many physicians are hesitant to prescribe drugs to healthy patients. Anticipating an upturn of patients asking neurologists for CE, the American Academy of Neurology Ethics, Law and Humanities Committee issued guidelines for their members (Larriviere et al., 2009). They suggest that these 'normal' adult patients – who do not require treatment for symptoms, disease, injury or disorder – become patients once the patient–physician relationship has been established. Moreover, prescribing CE therapies is likely to be considered ethically permissible by society and by the profession because, like cosmetic surgeons, physicians who provide CE therapies presumably do so to improve the well-being of their patients. Despite this, the limited evidence regarding the efficacy and safety of medication prescribed to normal adults for CE may dissuade many physicians from offering it. The neurologist's perception of potential harm may be very different from the patient's; the latter might view the risk as minimal. Thus, refusal to prescribe medication for CE is ethically and legally permissible. Although refusal may appear paternalistic, physicians have

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no ethical obligation to provide patients with treatment or medication simply because they want it (Larriviere et al., 2009).

Dubljević (2015), however, sees a problem with this 'gate-keeper' approach. The assumption that only medical doctors have the expertise to diagnose illnesses and prescribe therapy, conflicts at times with the view that every citizen should have the right to decide for him or herself whether to use enhancements or not. Under the so-called gate-keeper model, if a person's preferred choice is to use modafinil, a health professional needs to be consulted and will make the relevant decision. If the physician refuses, two socially undesirable consequences can result. First, the patient may reach out to alternative channels of distribution, for example, obtain medication illegally with a valid prescription, from individuals or online pharmacies that do not require prescriptions. The second is 'doctor shopping'. The first option opens up the possibility of uncontrolled and potentially unsafe products being used as enhancers. The second – doctor-shopping – could be circumvented by implementing sterner monitoring regulations under which physicians would be very careful not to overprescribe these drugs. Such a policy, however, would raise charges of governmental paternalism and consolidate the power of the medical profession over CE.

Cognitive Enhancement and children

Parents can be expected to try biomedical enhancements on their children, and indeed are already doing so to children who do not have diagnosed Attention-Deficit/Hyperactivity Disorder (ADHD) (Mehlman and Berg, 2008). This raises troublesome issues including the fiduciary responsibility of physicians to children, the special integrity of the doctor–child–parent relationship, the vulnerability of children to various forms of coercion, distributive justice in school settings and the moral obligation of physicians to prevent misuse of medication (Blitz, 2010). Given these concerns, the ANN Committee Ethics, Law, and Humanities Committee position paper concluded that prescribing stimulants for enhancement without diagnosis of a neurologic disorder is unjustified in legally and developmentally non-autonomous children and inadvisable for near-autonomous adolescents (Larriviere et al., 2009; Graf et al., 2013). Moreover, due to gaps in scientific knowledge, Davis (2014) called for 'extreme caution' in the use of TMS or tDCS even to treat neurological disorders in children. Davis calls attention to four major issues, framed as 'known unknowns' in the current literature: unknown effects of brain

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stimulation and unknown mechanisms for producing those effects; unknown side-effects of stimulation (both short- and long-term); a lack of clear dosing guidelines; and a lack of translational studies from adults to children. A child's developing brain may respond differently to stimulation compared to that of an adult. Therefore, as the intervention moves away from being a treatment toward being an enhancement, considerations of the child's best interests as judged by the parents diminish. As summarized well by Maslen and colleagues:

> While choosing to 'treat' a child will sometimes be in his or her best interests *even if* it precipitates cognitive trade-offs, interventions intended to 'enhance' may not be justified in this way. In the absence of clear pathology, we suggest, greater relative weight should be placed on the child's (future) autonomy, at least in part because the certainty with which the parents can determine what would be in his or her best interests is likely to be significantly reduced. Given this, we argue that brain stimulation for 'enhancement' – insofar as it involves a more controversial weighting of benefits vs. risks and costs – should be delayed until the child has reached a state of maturity. (2014: 2)

Likewise, Mehlman and Berg (2008) concluded that the Common Rule gives children special protections in research, but it is not clear how these provisions would apply to enhancement research with children, or whether they would provide adequate protection.

Moral enhancement before Cognitive Enhancement?

Savulescu and Persson (2015) conclude that widespread CE, and the consequent explosion of knowledge, may actually make us worse off. Even if only few individuals are malicious enough to use this new power for evil ends, this is an unacceptable increase of the risk of death and disaster. To eliminate this risk, CE would have to be accompanied by a moral enhancement which extends to everyone. Although the advances brought on by CE will almost certainly lead to a small increase of our quality of life, it will do so at the cost of increasing the risk of death in the future through the misuse of these advances. Moreover, if safe moral enhancements are ever developed, there are strong reasons that their use should be obligatory, since those who should take them are least inclined to do so. Carter and Gordon (2015) dispute this and argue that, while engendering a kind of cognitive flourishing, CE embodies certain kinds of moral improvements as well. Contrary to Savulescu and Persson, the aims of cognitive and moral enhancement are interconnected: just as there is a moral dimension to

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cognitive growth, there is a cognitive dimension to moral flourishing. Similarly, Hauskeller (2014) notes we may not be able to make people more moral, but we might be able to change their nature so that they are able to resolve global problems. Acknowledging this crucial distinction between morality being pursued as an end and as a means is likely to deflate the heated debate on whether or not people can, and should, be morally enhanced.

Summary: issues in CE

The issues surrounding CE are, indeed, imposing and have significant ethical, social, legal and policy ramifications. Although opponents often raise these issues as justification to proscribe CE, others argue that, even though CE presents problems they can be dealt with without precluding CE and its potential benefits. Ultimately, these issues must be dealt with in a public forum with public involvement. Therefore, before turning to the role of policy-makers in confronting these issues, it is important to examine what the current public attitudes regarding CE show. Then, because of the importance of the media in shaping public opinion, attention turns to the media and the commercial context of CE.

Public attitudes toward Cognitive Enhancement

There are many reasons to examine the attitudes of the public toward CE. According to Schicktanz et al. (2012), research on public opinion can point to remote or emerging moral problems, be used to examine premises about human behavior and social consequences of actions that underlie ethical arguments, and increase the context-sensitivity of ethical reasoning by pointing out consequences of concrete decisions in social policy. Any bioethical dialog that avoids public opinion not only runs the risk of missing important aspects, ideas and arguments, but also arouses strong suspicion of being one-sided or ideological. Despite the assimilation of CE into the media dialog, however, the extent to which people endorse it in everyday life remains unclear (O'Connor et al., 2013).

The public, of course, is not a monolith, but rather a conglomeration of numerous 'publics'. Although there are compelling arguments for including the views of the population at large in discussions of CE (see Chapter 3), to date, most opinion studies of CE are largely limited to the opinions of students, with only a few exceptions of studies on health care providers and

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the general public. Unfortunately, CE has not yet made it into national public opinion surveys. Furthermore, most studies were conducted with non-random availability samples or, in the case of random sampling, had a very low response rate that might have biased the results. According to Schelle et al. (2014), future research should provide more insight into the opinions of the general public or people active in the workforce. This would add to a more accurate picture of opinions of the general population and of potential users of CE in those areas where use is to be expected (Lucke, 2012).

An online non-random survey of over 4,000 adults from Canada and the U.S. found that, while the public recognizes ethical issues – such as, the nature of pressure to enhance; the authenticity of achievement under the influence of CE – they do not reject CE outright (Fitz et al., 2014). Although they found no evidence for widespread support of radical enhancement, overall the public appears to cautiously accept CE, even as they recognize its potential perils. Given the rhetoric emerging from the poles of the debate one might imagine that the populace is biopolitically polarized, but this study demonstrated that opinion is quite moderate. Furthermore, these data suggest that public attitudes toward enhancement are sufficiently sophisticated to merit inclusion in policy deliberations. Among participants from a workshop on CE, however, Nagel (2010) found that, while the development of CE drugs to delay or halt dementia was applauded, there was less support for their use in healthy people, for whom drug enhancement was seen to be 'unnatural' and less desirable than a good diet and plenty of exercise. People also expressed fears about the adverse effects of such drugs, equality of access to them, undue pressure to use them and their possible effect in devaluing unaided achievement.

Schelle et al. (2014) provide an excellent overview of 40 published empirical studies that have been conducted to assess public attitudes toward CE. Overall, they found that public concerns about the use of CE essentially match those discussed in the normative academic debate: medical safety, coercion, and fairness. These were divided into three subthemes: equality of opportunity, honesty and authenticity. Importantly, they also found significant differences between users and non-users of CE as well as among specific groups including students, parents and health care providers. While attitudes regarding some concerns, such as coercion, are consistent across studies others (e.g. authenticity) exhibit mixed results. One consistent finding was that non-users display more concerns regarding medical safety and fairness than users, although medical safety comes through as a central concern in many studies. Non-users also have a preference for natural enhancers and

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for interventions that might appear to be closer to treatment than not. On the other hand, those who have used CE are ambivalent regarding its health risks, other than addiction, and perceive CE to be less harmful than non-users. Of the few studies that have investigated potential coercion, most feel that CE should be a matter of personal choice while acknowledging that they might be influenced by perceived social pressure or competitive environments. In terms of equality of opportunity, there is a view that an unequal distribution of CE substances due to changeable factors, such as wealth, is unfair, while an unequal distribution due to biological dispositions, such as a low attention span, is less relevant to judgments of fairness. In general only half of the public raises concerns about honesty and cheating. Schelle et al. (2014) think it particularly important that users generally consider CE to be safe and fair while non-users do not. This implies either that users are more willing to engage in CE because of their positive attitude toward it, or, conversely, that they adopted their positive attitude as a result of personal usage. In either case, the differences in users' and non-users' attitudes toward CE might be driven by cognitive biases.

Caviola et al. (2014) suggest a number of cognitive biases that are likely to affect moral intuitions and judgments about CE as reflected by the above differences between users and non-users. They include: status quo bias, loss aversion, risk aversion, omission bias, scope insensitivity, nature bias and optimistic bias. The authors argue that there are more well-documented biases likely to cause irrational aversion to CE than biases in favor of it, suggesting that common attitudes about CE are predominantly negatively biased. These biases might explain why research reviewing the general public's attitudes towards CE has tended to show that lay people share many of the critics' concerns over safety, threats to autonomy, potential peer pressure, fairness and unequal distribution that are not commonly reflected in exaggerated reports by the media (Faulmüller et al., 2013; Schelle et al., 2014). Although Caviola et al. (2014) agree that these concerns about CE are justified at least to some extent, and that long-term safety of CE is not currently ensured (c.f. Urban and Gao, 2014), they conclude that the negative cognitive biases toward CE might partially explain the general public ambivalence to CE.

Vrecko (2013) maintains that previous studies of non-medical use of stimulants by university students have ignored important emotional dimensions of CE. He concludes that enhancement does not deal purely with cognitive augmentation and that changes of emotional states are a significant motivating factor in its use. Therefore, even though clinical research indicates that the capacity of stimulant drugs to improve performance on cognitive tests

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may be quite limited, pharmacological assessments show that an important mechanism of the action of stimulant drugs is their ability to influence the functioning of the brain's dopamine system, a system associated with pleasure and emotion, as well as attention (Volkow and Swanson, 2008). A conceptual framework of CE that presumes that individuals use these drugs solely to increase their intellectual powers fails to capture a highly significant dimension of stimulants' effects and can, thus, misrepresent or distort their increasing use (Vrecko, 2013).

While Ranisch, Garofoli and Dubljevic (2013) support Vrecko's introduction of non-cognitive aspects of stimulant drug use, they, in turn, contend that he ignores other aspects of stimulant drug use, such as performance maintenance effects. These include the prolongation of normal functioning and the reduction of fatigue and sleep deprivation, which are typically highly desirable effects. In such cases, enhancement is achieved by maintaining performance rather than by augmenting the cognitive capabilities of users, according to Ranisch, Garofoli and Dubljevic (2013). In an extension of this theme, Ilieva and Farah (2013) found that student users perceive stimulants as beneficial for cognition, despite the weak evidence for objective cognitive enhancing effects. However, student users also perceive stimulants as advantageous for motivation and energy. Not only were motivational functions found by users to be significantly enhanced, they were found to be somewhat more enhanced as a group than a category of cognitive functions; this difference was statistically significant. Therefore, stimulants' motivational effects are viewed by healthy users as prominent despite the common assumption that they work chiefly on cognition. According to students who use stimulants for CE, these drugs may enable better performance of cognitively demanding work, at least in part through their effects on motivation. These data support the hypothesis that enhancement users rely on medication to boost drive, energy and mood, rather than cognitive capacity alone.

In order to understand the public's views of tDCS, Cabrera and Reiner (2015) used a thematic analysis to compare online comments on popular press articles before and after the introduction of the first commercial tDCS product. They found that during that period the public's perception of tDCS shifted from misunderstanding to cautionary realism, suggesting that as the technology has become more grounded in the public domain, there has been a shift from a focus on an emergent technology to one based on its applications and risk–benefit profile.

In their two studies of university students, Scheske and Schnall (2012) found that respondents rejected CE drug use when there were long-term

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negative effects on health or when it resulted in an unfair advantage in an exam situation. Moreover, they were more critical of drugs derived from artificial, as opposed to natural, sources or in the form of an injection rather than a pill. They concluded that, at some level, people consider CE drugs a moral issue that elicits emotional responses. Thus, people might care not only about objectively problematic aspects, but also consider issues that have no rational basis. In other words, while some concerns about CE are rationally justified, others derive from intuitions which have no supporting evidence. In particular, concerns about the naturalness of CE drugs may follow a moral intuition based on a widespread belief that natural products are healthier than artificial ones. Overall, the students had little concern for competitive or distributive fairness, and peer pressure was not found to be a central moral concern for the participants. Scheske and Schnall (2012) reiterate that a 'complexity of concerns', whether based on rational considerations or on emotions and intuitions, needs to be taken into account in public policy decisions regulating the use of CE drugs. Thus, the question of whether society should approve or prohibit the development and use of CE is a moral one that is likely to continue to stir emotion and controversy.

It is expected that different sections of the public will have very different views regarding CE. One sector that might prove especially important politically is that of parents. In their study of the views of parents of healthy and cognitively disabled children, Ball and Wolbring (2014) revealed the complex attitudes held towards a variety of CE types for their children. Overall, parents were hesitant to have their children use CE products, with physical harm resulting from CE use identified as a central concern. Parents from both groups indicated that enhancements would be more acceptable if their child had a cognitive disability, but they were generally opposed to the use of drugs, natural products, surgery or removable devices for the sole purpose of CE in 'healthy' or non-disabled individuals. They believed that it could damage a child's self-esteem, risk putting their child's physical health in jeopardy, and/or perpetuate unhealthy levels of cognitive competition between children. They were more open to CE techniques, if they could be proven to be safe, in cases where using them would help their child to 'fit in', but only once the child was able to fully grasp the benefits and drawbacks of CE. When presented with a scenario where their children were put at a disadvantage because other children were using CE, some of the parents acknowledged that they would be more interested in CE. Therefore, while parents were generally hesitant about CE use currently, Ball and Wolbring (2014) suggest that opinions may shift

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if products become more popular. In any case, the parents felt that CE use should be monitored by a health care professional as a way to mitigate risk, since health practitioners would likely have greater knowledge of the risks and effectiveness of CE products.

The media and the internet

Although CE applications have yet to enjoy the media coverage of other areas of biomedical research, both the popular press and, especially, the Internet are predisposed to highly optimistic and oversimplified coverage of all biomedical technologies. In addition, health-oriented magazines and television shows extol the virtues of medical innovations and the quick fixes or breakthroughs these innovations might offer. By and large, then, media coverage solidifies public trust in the technological fix and stimulates its appetite for new, often expensive, high technology procedures. Participants at a National Science Foundation (NSF) neuroscience workshop, for instance, expressed dismay at many fMRI-based behavioral inferences that have found their way into the popular press and are circulated broadly (Lupia, 2011). Moreover, the media seems to relish uncovering and sensationalizing cases where access to treatment is denied. Not surprisingly, there is considerable debate over the lapses in procedural transparency and rigor that often accompany such media claims (O'Connell et al., 2011).

Gilbert and Ovadia (2011) document many instances of hype and exaggerated coverage of DBS in scientific journals and the popular press. For instance, even the highly respected *Nature* (Abbott, 2008) presented DBS findings in an overly optimistic article entitled 'Brain electrodes can improve learning' that was quickly followed by highly enthusiastic coverage in television news and the press that headlined 'Deep stimulation "boosts memory" ' (Gilbert and Ovadia, 2011: 3). There seems little doubt that the media remains an important component of the hype phenomenon. In general, studies of the content in news articles have found that while they often include balancing material, they still tend to be slanted toward an optimistic view of CE. Not surprisingly, the headlines for stories about CE research frequently are even more overstated than the news stories that follow. Media coverage is also influenced by a tendency of the journalist community to turn to a narrowly defined core of experts and to politicians as their primary sources of information for news coverage in general (Caulfield and Condit, 2012).

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Newspaper articles have also been found to exaggerate the prevalence of CE by describing it as widespread, even though the largest and most representative surveys to date suggest a past year prevalence of non-medical stimulant use of only 3 to 6 percent (see Chapter 1). Partridge et al. (2011) found that, while two-thirds of media articles did refer to the academic literature in some way to support their claims, they often misinterpreted the data or presented it in ways that amplified its prevalence: for instance, by highlighting the minority of studies with higher estimated use, and failing to report important qualifications of the data. Overall, most newspaper articles were found to portray CE as common or increasing in prevalence. This practice runs the risk of normalizing such use and encouraging others to engage in it (Forlini and Racine, 2012a). Or, as embellished by Hurley, 'tDCS has been shown in hundreds of studies to enhance an astonishing, seemingly implausible variety of intellectual, emotional and movement-related brain functions' (2013: 1).

There has been substantial trepidation articulated over messages about science hype that exaggerates the benefits of research and underplays the costs and risks of CE science and its technological products. According to Makridis (2013), the media has shaped the development of nootropics through its rhetoric, referring to CE products as breakthroughs and wonder drugs. In this sense, the selection and tone of information in the media has a significant impact on advancing CE development. Caulfield and Condit (2012), however, argue that no one entity is singularly responsible for the hype phenomenon and that substantial evidence shows that it does not originate solely or primarily with the press, but rather is a product of the input and incentives of a diverse array of entities, including scientists, funding agencies, business interests, the public and even the current academic publication process.

Exaggerations of therapeutic effect in media articles have largely been found to be faithfully reported from the conclusions of scientific articles (Gonon et al., 2011). In fact, if anything, the media might be overly deferential to claims made with the authority of science, claims that are often highly speculative. Moreover, a momentum or spatial dynamic (Brown, 2003) may exist whereby expectations of positive outcomes are generated from little evidence due to the interaction of multiple stakeholders: research communities, funding agencies and patient groups, as well as the media. According to Outram (2010), speculation over the ability of methylphenidate for CE may have introduced 'a cycle of expectation.' This expectation, like the speculation it arises from, has a loose connection to the empirical evidence, making

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it resistant to detailed discussion of the limitations of current efficacy data, which would curtail interest (Wade et al., 2014).

One example of this pattern is provided by Wade et al. (2014) in their analysis of how donepezil, an acetylcholinesterase inhibitor used in the treatment of Alzheimer's disease, became considered a cognitive enhancer for healthy individuals. Virtually all media and bioethics reports enthusiastically portrayed a beneficial CE effect of donepezil. Importantly, they all relied heavily on the results of a single study (Yesavage et al., 2002) which, in addition to being a very small study of airline pilots with limited results, is open to diverse interpretations. The majority of headlines and titles used enhancement language and most suggested that donepezil could be used to boost intellectual ability, this despite lingering questions even over the medical value of donepezil in treating dementia (Repantis et al., 2010). The general finding of Wade and associates is that both the media and the academic literature often magnify the limited conclusions that can be drawn from basic research, making them congruent with expectations that are heavily influenced by prominent social pressures. 'A complex interaction between the authors of primary and secondary literature, generated in part by the tenuous distinction between treatment and enhancement that sets the premise for the CE debate, and in part by the presence of widespread expectations and social pressures, may contribute to this phenomenon' (2014: 18).

Partridge et al. (2011) conducted an empirical study of media reporting of CE to explore portrayals of the prevalence of CE, the types of evidence used by the media to support claims about its prevalence, and the possible benefits and risks mentioned in these media articles. In a thematic content analysis of 142 newspaper articles, 87 percent mentioned the prevalence of CE and 94 percent portrayed it as common, increasing or both. While 66 percent referred to academic literature to support these claims, 33 percent cited no evidence and 15 percent depended on anecdotal evidence. Ninety-five percent of articles mentioned at least one possible benefit of using prescription drugs for CE, but only 58 percent mentioned any risks or side effects. Only a minority of articles expressed doubts about, or questioned the evidence for, the efficacy of prescription drugs to produce benefits for users, even though the many reviews indicated only modest evidence for their cognitive enhancing effects.

Distorted reporting, commercial pressures and other factors can result in the misuse or misapplication of neuroscience (O'Connell et al., 2011). This pattern of extolling medical and scientific innovation, while giving little if any attention to ethical issues and technical constraints, risks turning ethical

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neglect into de facto ethical approval, thereby promoting public acceptance of these technologies without full knowledge of their risks and limitations (Clausen, 2010; Racine et al., 2010). In a formative study, Racine et al. (2007) reviewed 235 articles on neurostimulation techniques in the print news media in the U.K. and the U.S. and found that 51 percent were optimistic depictions while only 4 percent emphasized the risks. Moreover, of the articles reviewed, 29 percent contained a 'personal twist', including first person narratives and descriptions of 'miracle stories of patients cured of Parkinson's disease, dystonia, and Tourette's syndrome' (Racine et al., 2010).

At the same time, there is increasing evidence that patients educate themselves and build their hopes from sources such as television and the Internet (Schneiderman, 2005). From the point of view of the lay person or potential psychiatric patient, a highly positive media depiction of a technique can be far more influential than the often austere and subtle explanation found in specialized journals. Ford (2009) agrees that overly optimistic reports about new neurosurgical innovations generate an educational vulnerability for patients. He affirms that, very often, when patients consider neurosurgical techniques, they have already been preconditioned by buoyant media portrayals of novel brain interventions, thus compromising informed consent. Furthermore, passionate, unbalanced media accounts can convey to the general public and potential patients unrealistic hope and act as a baseless promotion of the technologies (Schlaepfer Lisanby and Pallanti, 2010; Bell et al., 2009).

Although we expect the media to play an informative and investigative role, with regard to neuroscience they seldom provide critical analysis or question the assumptions under which the original findings were presented. Promises of success are used to frame headlines that attract public attention in a news world where every article needs drama in a competitive struggle to be noticed. Such 'creative' headings are most common on Internet search sites and numerous blogs dedicated to CE. The need for more responsible reporting, from popular media as well as neuroscientists and neurosurgeons themselves, demands not only closer monitoring, but also better mechanisms for communication among all parties (Racine et al., 2010; Ford, 2009). Given the limited knowledge of the public and its inability to distinguish fact from opinion regarding neuroscience, distorted reports lacking technical or ethical details provoke social and ethical concerns. In order to reduce such misconceptions, it has been argued that neuroscientists must learn to be more effective in conveying their discoveries to the public (Racine et al., 2010; O'Connell et al., 2011).

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During the course of their comprehensive analysis of media coverage of neuroscience, O'Connell et al. (2011) also uncovered several other tendencies in the general media, including a failure to report how factors such as sample size can affect both the interpretation of results and the extent to which the findings might apply in different contexts. There was also evidence that some journalists have explicitly distorted the interpretations of the researchers in order to make the story more impressive; and, likewise, evidence that some researchers misrepresent or overstate the importance of their research in order to attract media attention. Moreover, it has been found that individuals affiliated with commercial interests receive a disproportionate amount of media attention as a result of deliberate marketing to increase business revenue (O'Connell et al., 2011). This, in turn, can lead to a polarized, positive slant in the media, where much of the 'news' is based on public relations efforts on behalf of the companies that sell the products.

In summary, overly enthusiastic media coverage of applications of neuroscience research in general can unrealistically raise public expectations about their future impact for good or ill (Racine et al., 2010). These findings have several implications of concern. Firstly, misleading media reporting increases the likelihood that public policy with be poorly informed (Wade et al., 2014). If CE is believed to be widespread and effective for improving concentration or getting better grades, then policies may mistakenly be developed to facilitate such use. A second concern is about the possible impact of media reporting of CE on individual behavior. While the long-term social consequences of drug use for CE purposes remain unknown, there is a risk of inducing a medicated normality that encourages use. If, as Forlini and Racine (2009) found, health care providers, students and parents all view the media as an important source of information about CE, misleading media accounts may undermine responsible public debate and heighten personal use (Partridge et al., 2011).

Commercialization of Cognitive Enhancement

As noted above, a related area of concern centers on the commercial use of neuroscience. As we've seen, CE raises many legal, ethical and political issues. Although these issues challenge traditional values and law, the introduction of the commercial dimension complicates matters and, in some ways, simultaneously normalizes it by making it just another set of products

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to be marketed and sold. Similarly, the direct marketing of CE products to consumers via the Internet and other media sources is a large growth area, as illustrated by the multi-billion dollar nutritional supplement market. For instance, while Ritalin was the market leader in treatments for ADHD for many years, aggressive marketing campaigns by Eli Lilly and others have increased the use of drugs such as Concerta, Adderall and Strattera. Not surprisingly, the use of drugs for ADHD in the U.S. is vastly out of proportion to that of other countries and accounts for about 85 percent of the world's use (Singh, 2005). In addition, new psychopharmaceuticals and cognitive fitness tools – like those being developed by Posit Science, Luminosity and other firms – have expanded the neurocentric health market. These products will likely be followed by progressively sophisticated neuromodulation, cognitive prosthetics and neurofeedback technologies, as they move from the laboratory into mainstream use over the next few decades (Dunagan, 2010). Unfortunately, a comparative analysis of Internet-based advertising for neuroscience products shows that existing mechanisms for monitoring the promotion of prescription drugs are being strained and, as technology develops, the information that regulatory bodies will need to be able to oversee will further challenge their already fragile oversight mechanisms (Illes and Bird, 2006).

Direct-to-consumer advertising of health care products refers to a variety of marketing practices based on a combination of information and promotion strategies directed at consumers through multiple media: radio and television, newspaper and magazines, phone or mobile solicitation; and, of increasing importance, the Internet (Racine, van Der Loos and Illes, 2007). Direct-to-consumer advertising in the U.S. has contributed to burgeoning pharmaceutical marketing and sales in the last decade. Not surprisingly, these changes parallel changes in social perceptions on the acceptability of drugs as the solutions to cognitive challenges. In recognizing that the development, marketing and sale of pharmaceuticals is reaching unprecedented levels, Schanker (2011) notes that some are calling the current generation, 'generation Rx'. It is estimated that prescriptions for ADHD stimulants for those aged 20 to 30 tripled between 2000 and 2007, an increase in part 'fueled by drug-seeking students who exaggerate or feign symptoms in order to acquire an ADHD diagnosis' thus providing them with a continuous supply of cognitive stimulants. Although proponents of direct marketing argue it precipitously exposes the public to innovations, empowers patients and provides updated health information directly to potential users, Palmour and Racine (2011) view direct-to-consumer marketing of dietary

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supplements to enhance or maintain cognition as an unhealthy commerce of neuroscience.

Although expectations of scientific discoveries need to be carefully framed in the context of their limitations in order to avoid abridging findings beyond scientifically acceptable limits, evidence shows that marketing and direct-to-consumer services provide little or no detail of technical shortcomings (Ariely and Berns, 2010). Commercial companies rarely disclose that the reliability of their methods is uncertain due to under-developed evidence bases and the absence of replication of their findings by other investigators (Spence, 2002). Despite this, leading proponents of commercial services regularly use media outlets to promote their work through solicited op-ed features, personal blogs and websites and merchandizing. By contrast, many academic neuroscientists are not media savvy and are unable to communicate their more objective versions to the public. According to O'Connell et al. (2011), as the interaction between neuroscience and the media increases, it will become necessary to establish guidelines for the professional conduct of neuroscientists participating in dialog with the media and industry.

According to Chancellor and Chatterjee (2011), however, products that align themselves with basic and clinical neurosciences make money. They have three concerns about 'brain branding' when commercial interests threaten to compromise scientific and clinical values. The first is the insidious effects of blurred boundaries between academia and industry, as typified in drug development and dissemination. The second is of commerce getting ahead of the motivating science, epitomized by the sale of brain fitness products. And the third is the misuse of neuroscience in marketing technology. The tremendous growth of neuroscience knowledge in recent years, the hold that it has on the public imagination and the vulnerability of the population in need of these technologies, combined with potentially huge financial gains, give 'brain brands' a special place in this evolving market. The authors are most concerned when unregulated health care products – such as cognitive 'brain fitness' software programs – are heavily marketed to people who are concerned about their cognitive decline. These products could yield substantial profit well before evidence of their efficacy has been established.

Although the entrepreneurs often maintain their products are based on scientific research, much of the research is sponsored by the companies themselves, or is conducted by authors with a financial stake in the outcome of the studies reported. Elsewhere, some companies cite peer-reviewed

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research involving company software, but their claims do not always match the actual findings. As noted in Chapter 1, companies that sell brain fitness programs attempt to boost their credibility by relying on the authority of scientists that design the products or have company affiliation. Lumosity, for example, boasts of having a scientific advisory board of academicians from Stanford University and the University of California-San Francisco. The company claims that its training improves memory and attention, although no scientific data using their actual software are offered (Lumos, 2009).

Dr Oz says 'It's the future of the brain'. The World's 11th richest man says that, since taking this IQ boosting pill his 'creativity, problem-solving and focus have increased significantly'. David Letterman avers that he extended his TV career by ten years because of this drug; Tiger Woods wishes he had taken it earlier in his career; and CNN Breaking News reported that this 'clear-pill' is so effective that the government is thinking of banning it. Interestingly, as shown in Chapter 1, the name of this wonder supplement varies, including Alpha ZXT and Geniux, among others. The ads even include 'limited edition cover pages' of magazines such as *National Geographic, Forbes* and *Time* extolling the 'most powerful brain enhancer on the planet' and the pill that can turn you into 'the quickest thinker on the planet!' According to their website, Geniux has been clinically proven to 'sky-rocket concentration by 312 percent, improve creative thinking, boost energy, enhance memory recall and increase IQ scores by 77 percent.' It boasts that studies have revealed it boosts brainpower by up to 89.2 percent and sharpens your mind with no side effects or health risks. Moreover, after several years and over 2000 trials at The Nottingham Clinical Trials Unit, Geniux pills are proving that the superhero-making drug is more powerful than ever. Many thought something like this wouldn't happen for another hundred years; but, as Dr Raqif said on the Dr Oz show, 'welcome to the future'.

With so much 'media acclaim' and countless personal testimonies from celebrities experiencing success with Geniux, *The Discover Magazine* wanted to 'verify whether this wasn't just all hype so we tested it ourselves.' After almost every single 'man' in the building volunteered they chose their Senior Chief Editor, whose account of the four-week trial shows it exceeded all expectations. Moreover, their resident 'brain scientist', Dr Raqif, conducted his own independent analysis of the supplement and concluded 'he's never seen a food based supplement deliver such a profound upward lift in brain function before.' Not surprisingly, it has been quickly gaining traction around

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the world. Celebrities and entrepreneurs are 'believed' to be taking the pill. Moreover, Alpha ZXT (Geniux, whatever) is the only pill of its kind where the user benefits and grows the more pills he or she takes. Normally, the body gets used to medication, but in this case, throughout all trials all users continued to make progress over time. 'With such overwhelming evidence and media mention, the question is not whether the pill works, but whether it should be legal.' Of course it should! 'In fact, the truth is the health and safety of the product was never a concern. Major competing companies created uproar due to their heavily sinking profits when Alpha ZXT was becoming widely used. Even more companies are joining in this time so we have no doubt that production of Alpha ZXT pills will be stopped once again, so order your supply while it lasts.'

In the same vein, what if tDCS could improve your memory, expand your problem solving abilities, or even help you learn new information up to twice as fast? According to the first webpage that appears on Google Search, researchers have been studying the CE benefits of tDCS for years, and the results they've uncovered are 'astounding'. The Brain Stimulator is the industry leader in tDCS they trumpet. Products available include: The Brain Stimulator Travel Model – Only $55; The Full Featured Brain Stimulator – Just $90; The Brain Stimulator – Advanced Started Kit; Travel Model – Detachable Electrode Wires for Portability; The Smallest tDCS Device Available; plus adaptors and carry pouches. Among the 'endorsements' noted are a TV doctor, an article in the *New Yorker* and a Public Broadcasting System (PBS) story. After a short description of tDCS, the website states that tests on healthy adults demonstrate that tDCS can increase cognitive performance on a variety of tasks, depending on the area of the brain being stimulated. Scientific studies have shown that tDCS has the ability to enhance language and mathematical ability, attention span, problem solving, memory and coordination. In addition, tDCS has been 'documented' as having impressive potential to treat depression, anxiety, Post Traumatic Stress Syndrome (PTSD), as well as chronic pain. After discussing technical details on how to use it, in small print on a link, is this:

> ***Important Note*** This page is provided for informational purposes only. None of this information should be viewed as suggestive or actionable. Do not view this data as absolute fact. It is recommended that you conduct your own research to come up with your own conclusions. None of the statements located on this page are supported by the Food and Drug Administration (FDA). Neurolectrics Inc. does not take responsibility for the validity or context of any information on this page. (The Brain Stimulator, 2015)

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Another example of the marketing of tDCS comes from the Brain Stimulation Clinic (2015), which advertises that tDCS is a safe, new, non-invasive procedure which improves attention, memory and learning for both healthy individuals and patients with disabilities. It is performed at the clinic in Atlanta or can be self-administered with training and supervision through the Home-Use Program.

As these examples illustrate the commerce in brain games, brain supplements and, to a lesser extent, electronic stimulation, are examples of products that, while designed with conceivable scientific rationales, have moved ahead of the science. The marketing of these products often exaggerates or misrepresents the science that motivates their production. For credibility, the companies rely on the authority of selected scientists and anecdotal testimonials. Although some of these products may eventually prove to be effective, they are being hawked long before their efficacy can be substantiated. Racine, van Der Loos and Illes (2007) conclude that a lack of public scrutiny allows companies to make claims that are not always justifiable. Chancellor and Chatterjee (2011) suggest that consumers are susceptible to these claims because of the general allure of neuroscience, the power of images and the potential vulnerability of patients.

Of equal importance, however, is the technological fix and medicalization mentality of Western society, which, as discussed in Chapter 1, assumes that most physical and mental ills are avoidable and can be treated by a medical model that applies simple, quick fixes. According to Caulfield and Condit (2012), since this is what commercialized technology offers, there is a good fit between the expectations of a significant proportion of the public and the vision of being offered a quick solution. The convergence of the predisposition of the media toward highly optimistic coverage, aggressive marketing of CE products, coupled with an active sector of the public who find 'the quick fix' perspective of CE attractive and the lack of government involvement, has contributed to a largely unrestrained CE marketplace. This situation has led some (Hanrahan, 2013) to call for greater regulation over the direct-to-consumer advertising of such products to close the existing breach. As argued by Racine, van Der Loos and Illes (2007), the commercial development of neurotechnologies deserves greater regulatory attention because of the exceptional ethical considerations they evoke. At the very least, consumer protection against false advertising and to guard against potential long-term safety problems would seem to be urgent in the growing commercialized CE environment. This question will be re-visited in Chapter 4.

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3

Policy and Politics of Cognitive Enhancement

Abstract: *The chapter opens with an overview different perspectives that guide policy options that are available to policy makers to regulate research, marketing and individual use of CE technologies. As noted above, while all of these potential enhancement techniques elicit the same broad social policy concerns, they (especially the physical interventions) differ widely in efficacy, potential usage and risk; and this must be recognized in efforts to regulate their use. The role of the public and experts in CE and difficulties of getting it on political agendas are also discussed.*

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Although the public health/scientific and bioethics literatures, as well as the media discussed above, have necessarily touched upon the political and policy dimensions of CE, with few exceptions the latter have not been emphasized. Although the issues underlying CE will continue to be debated in ethics and science, eventually they must get adjudicated in politics. Hence, entering the realm of politics becomes unavoidable and promises to be contentious (Shook, Galvagni and Giordano, 2014). The move of the CE debate to the policy domain alters the context by bringing to the forefront political considerations and divisions, and placing the resolution of these issues in the milieu of interest-group politics. With the high economic, social and personal stakes surrounding CE, this is unavoidable. Moreover, the lack of reliable information on current trends and future developments, and of policy guidance, has created a gap that has been filled with 'thought experiments and fictional scenarios' (Dubljević, 2015: 343) that lead to even more misunderstanding. As noted by Hyman (2011), these applications not only raise traditional bioethical questions, but also engage broader communities that are not often represented in discussions of bioethics.

As discussed in Chapter 2, CE raises challenging policy issues and trade-offs that reveal a need for more systematic, anticipatory analysis of the social consequences of these possible game-changing innovations. As noted by Makridis (2013), the gap between the rapid rate of advance of enhancement technologies and slow development of the legal, social and economic frameworks poses significant challenges for policy makers. Moreover, our heavy dependence on technological solutions to health and social problems makes it difficult to curtail or slow the diffusion of the latest drug or procedure. Moreover, as noted in Chapter 2, media hype, active marketing and publicity often promote their use long before the risks of intervention are fully understood. Thus, although the available evidence indicates that the use of CE is relatively limited, especially outside the U.S. student population (see Chapter 1) this is destined to change in the near future. Rather than reacting retrospectively to the inevitable issues that the widespread use of CE will engender, now is the time for anticipatory policy-making. To this end, Forlini and Racine (2012a, 2012b) advocate deliberative or other democratic processes to recognize and incorporate the complexity in understanding the values of numerous stakeholders in the CE debate.

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Frameworks for Cognitive Enhancement policy

The Advanced Concepts Group at Sandia National Laboratory identified four perspectives on CE technologies, which are useful here for framing policy (Sarewitz and Karas, 2007). The *laissez-faire* view stresses the freedom of individuals to seek and use enhancement technologies based on their own judgment of potential benefit. Although the government might have a limited role in regulating the use of these technologies by funding research and ensuring the safety of new applications, the economic marketplace is the central mechanism for developing and distributing them. Regulation of particular technologies is not out of the question, but only with unequivocal evidence of harm. The second perspective, m*anaged technological optimism* agrees that CE technologies promise abundant benefits to individuals and society, but holds that active government participation is necessary to promote innovation, ensure efficacy and fairness and manage risk. Because of the rapid pace of technological change, however, regulation can be an ineffective instrument of governance. Moreover, the governance of CE does not lie strictly in the domain of formal government policy-making, but in the interactions among government, business and non-governmental organizations.

While the first two perspectives stress the benefits of technological enhancement, *managed technological skepticism* presumes that quality of life arises more out of a society's institutions than its technologies. Because markets are viewed as profit driven, not quality-of-life maximizing, the government has a crucial regulatory role to play. Moreover, the potential for enhancement technologies to affect society negatively merits consideration of a range of policies such as the creation of an independent body to provide expert social impacts assessments of enhancement technologies, robust regulation and oversight of human subject research on enhancement and close oversight of clinical trials (Sarewitz and Karas, 2007).

The last perspective, most clearly articulated by the bio-conservatives, *human essentialism*, starts with the notion of a human essence (God-given or evolutionary in origin) that should not be modified because that could destabilize individual quality of life and social relations in unforeseeable ways. The role of government is to restrict enhancement research and its use when it threatens these essential human qualities. A more moderate essentialist policy agenda would develop a process that drew lines

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between appropriate and unacceptable enhancement technologies. At the extreme, the government could prohibit specific, or potentially all, enhancement techniques.

Each of these perspectives encompasses a distinctive combination of values and preferred policy decisions. Furthermore, they are all subject to ethical uncertainty, created by the unknown future direction, pace and outcomes of CE itself. Therefore, although highly provisional at this time, a vigorous public dialog among these competing perspectives offers an opportunity for a prospective and adaptive governance of CE technologies instead of relying on a reactive crisis response after they proliferate. A rational, evidence-based policy informed by a wide array of relevant experts and stakeholders is needed. Greely et al. (2008) propose four types of policy priorities that include: (1) an accelerated program of research to build a knowledge base concerning the usage, benefits and associated risks of CE by healthy individuals; (2) professional guidelines for those who have a role in dispensing, using or working with people who use cognitive enhancers; (3) public education provided by physicians, teachers and others to increase understanding of CE; and (4) new or amended laws and regulations to take account of emerging social norms and information about safety and risk. The remainder of this chapter focuses on the last of these areas, laws and regulations, and contends that how the issues are framed depends on which of the above perspectives one brings to the table. Chapter 4 will then turn to Greely and associates' call for an active research agenda on CE.

Policy dimensions

Although many of the specific issues raised by CE are distinctive, fundamentally the policy dimensions are similar to other areas of biomedical research. Fundamentally, there are three relevant policy dimensions (Blank, 2013). First, decisions must be made concerning the research and development of the techniques. Because a considerable proportion of this research has been funded either directly or indirectly with public funds, civilian and military, it is important that public input be included at this early stage. The growing prominence of forecasting and assessing the social as well as technical consequences of technologies early in the process represents one means of incorporating broader public interests.

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However, it remains problematic as to how to best design assessment processes to evaluate efficacy, short-and long-term safety and the social impact of CE drugs and techniques, especially when there is already a growing market and demand for them.

The second policy dimension relates to the individual use of technologies. Although governments are wary of intruding on individual decision-making in the medical arena, they can, by their nature, directly or indirectly influence such decisions: through taxes, services, licensing and educational programs. Although conventional regulatory mechanisms might be utilized to protect potential users or targets of CE applications, it is critical that their safety, efficacy and applicability first be determined. Despite much debate over the potential or actual ethical and social impacts of human enhancement, however, the motivations as to where the desire of individuals to be enhanced or not originates have been poorly investigated (Menuz et al., 2013).

The third dimension of enhancement policy centers on the aggregate consequences of widespread usage. What impact might widespread enhancement have on society? Will it aggrandize social inequalities or break down economic barriers? Should it be a high priority for public funding? Policy-making here requires a clear conception of goals, extensive data to predict the consequences of each possible course of action, an accurate means of monitoring these consequences and mechanisms to cope with consequences deemed undesirable. At a minimum, the government has a responsibility of ensuring safety and quality control standards as well as consumer protection and fair market practices.

Martin and Ashcroft (2005) present useful distinctions that can be applied to the regulation of CE technologies. The *institutions* of regulation range from local ethics committees, to the courts, to subnational and national bodies, both private and public. The *functions* of regulation can entail safety requirements, restriction of access to a specific class of users, deterring abuse or misuse and so forth. The *impacts* of regulation may be desired and expected, desired and unexpected, undesired but expected, or undesired and unexpected. Complicating the process is the fact that the impacts of regulation may affect various segments of society differently. The *subjects* of regulation are both those who are regulated and those who are affected by such regulation, while the *principles* of regulation relate to the extent to which regulatory policy is designed with specific moral or social principles in mind. Finally, there are various *styles of regulation* – centralist or democratic, formal or informal,

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egalitarian or libertarian with respect to distributive justice, and libertarian or communitarian with respect to criminal justice.

Government involvement, then, can occur at many points from the research and innovation stages, through placing a technology on the market, to the use of the technology by private individuals (Maslen et al., 2014). Table 3.1 illustrates the various forms that a governmental response to CE could take from the earliest stages of research to the use of specific techniques. Basically, CE policy can be permissive, affirmative, regulatory or prohibitive. Theoretically, a government can opt to take no action, thus allowing unfettered activity by the private sector. Or, it can make affirmative policies that promote or encourage certain activities, for example, public funding of research or provision of services to facilitate use of a particular CE technique. The question of whether the government ought to be providing such encouragement, and if so by what means, will be a matter of debate. Should public funds be used to pay for enhancement interventions when patients cannot afford them? Should private insurers be required to cover these expenses? Should we even distinguish among therapeutic and enhancement uses of a drug? Moreover, affirmative policies are often redistributive, and thus introduce potential conflict between the negative rights of individuals to use their resources as they see fit and the positive rights of recipients of government support. Also, in some instances, the line between encouragement and coercion or mandate is easily broached.

Although far less common than regulation, prohibitive policies could be implemented that would reduce or even eliminate the options available at each stage for CE. The most straightforward form would be to create laws that impose criminal sanctions on a particular research activity or application. Shook, Galvagni and Giordano (2014), however, note that, while targeting specific CE techniques for legal bans has the merit of objective verification, it is likely to encourage those seeking improved types of cognitive performance to find alternative CE methods not yet banned and also liable to foster a black market. On these grounds, Cakic (2009) contends that it is doubtful that any such policy could ever be

TABLE 3.1 *Types of governmental involvement in Cognitive Enhancement*

Ban or Prohibit technology	Regulate technology	Discourage individual use	Take no action	Encourage individual use	Mandate use of technology

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effectively enforced. Similarly, Foddy and Savulescu (2007) assert that any attempt to prohibit any performance-enhancing drugs is condemned to failure, not because of ethical considerations, but rather the expectation that any attempt at prohibition is not pragmatic and possibly more harmful than regulation. Moreover, as Forlini and Racine (2009) point out, it also would be very difficult to ban cognitive enhancers because of their routine use for therapeutic purposes. A softer type of prohibitive policy is to preclude public funding of specific areas of research and development (e.g. as has been done with certain types of fetal or human embryo research) or specific enhancement services. It remains to be seen what, if any, methods of CE are candidates for prohibition, but governments do have that option, as evidenced by bans on electroconvulsive therapy in some jurisdictions. Not surprisingly, these policies often reflect political motives or a response to the demands of particular interest groups.

Since it is unlikely that any CE methods could successfully be banned, attention here focuses on regulation. The most obvious examples of current regulations are psychoactive drugs, including those used for CE (Flaskerud, 2010). For instance, the legal framework for established stimulants is unambiguous and unified internationally under the United Nations' Convention on Psychotropic Substances, which explicitly lists methylphenidate and amphetamine as Schedule II drugs (dangerous substances with known medical uses). All countries that have signed this Convention are obligated to regulate them accordingly (Dubljević, 2015). Moreover, while the research and development phases of all pharmaceuticals is highly regulated by the Food and Drug Administration (FDA) in the U.S., and by analogous bodies in other countries, control of individual use is problematic, as is potential overuse in the aggregate. A broader regulatory approach would require assessment of the social and ethical ramifications by focusing attention on the various social processes involved in moving a technology along the different axes of regulation. A good example might be Ritalin, which has both official and unofficial uses. The unofficial uses employ the legal power to control illicit amphetamine use, while the official uses rely on the soft forces of parental and teacher approval for its use and the harder forces of official approval for stricter control of errant children's behavior (Ashcroft and Gui, 2005).

Although regulatory policy could be designed to apply only to government-supported activities, it normally consists of sweeping rules governing activities in both the public and private sectors. Regulation

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can be used to ensure that standards of safety, efficacy and liability are adhered to, and unlike professional association guidelines, which can set minimum standards for members, regulations have the force of law and usually include legal sanctions for violations (Greely and Illes, 2007). Moreover, as discussed later, an important regulatory device is price, which can be modified through taxation or license fees. Regulation of CE drugs could follow an approach similar to policies on tobacco products: a combination of taxation, bans on marketing and display, plain packaging with graphic pictures, and limits on where the products can be sold and used. Dubljevic (2013), however, doubts such an approach is well suited to medical drugs, such as Ritalin and Adderall, that have serious known side effects – it would be too permissive to sell them over the counter, even with sufficient warning.

Another option would be to require enhancement licenses to ensure informed consent and enable better monitoring. Dubljevic (2013) suggests that a government agency such as the FDA could offer a licensing procedure to pharmaceutical companies to market enhancement drugs for healthy adults. Moreover, in order to use them, citizens would have to pay for and pass a course about known effects and side effects. Furthermore, additional medical insurance and obligatory annual medical tests would be required in order to obtain and renew a license to use them. In addition, the prices could be regulated and an additional tax imposed. According to Dubljevic (2013), such a policy could ensure that all citizens have legal access to the drugs, but the imposition of taxes, fees, and requirements of additional insurance, would offset any positional advantage from their use. A downside with enhancement licenses is that people with low cognitive capacity, who might have the most to gain from enhancements, might find it difficult to get access if the license requirements were too demanding (Bostrom and Sandberg, 2009).

Similarly, Bostrom and Sandberg (2009) contend that the current system of licensing drugs is an obstacle for CE because drug companies are not likely to get regulatory approval for a drug designed solely to improve cognitive functioning in the healthy population. To date, every drug offering a CE effect was developed to treat a specific medical condition but has the enhancing side effects of these drugs' serendipitous benefits. If drug companies could develop nootropics directly, rather than having to proceed indirectly by demonstrating that the drugs are efficacious in treating some recognized disease, progress would accelerate. Moreover, as noted in Chapter 1, the disease-focused medical model

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medicalizes many conditions that were previously regarded as part of the normal human spectrum, often meaning that in order to legally obtain a drug the person must be first labeled with a disease. One result of this apparent inconsistency is that while Major League Baseball infielder Miguel Tejada received a 105-game suspension for testing positive for Adderall, under the League's amphetamine policy, 116 players received 'therapeutic-use exemptions' granted by the League's medical staff for players diagnosed with ADHD, thereby allowing them to use the identical substance without repercussions (Passam, 2014). For Singh et al. (2013) globalization of ADHD and the rise of CE have raised fresh concerns both about the validity of ADHD diagnosis, itself, and the ethics of stimulant drug treatment.

Figure 3.1 illustrates a broad range of possible specific policy positions in response to CE. Many of these options have been used by various

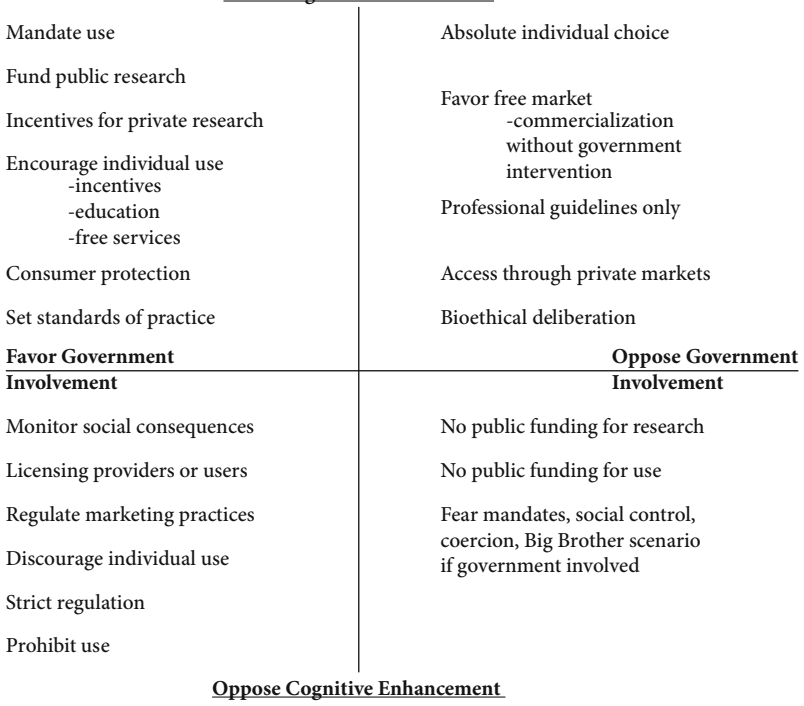

FIGURE 3.1 *The role of government in Cognitive Enhancement*
Source: Adapted from Blank (2013).

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countries with regards to stem cell research, reproductive and genetic technologies or other interventions in the brain. This array clearly demonstrates the diversity of policy options as well as the often diametrically opposed positions on the role of the government. Given the history of CE debate, dominated by the transhumanists at one extreme and the bio-conservatives at the other (Reiner, 2013), there appears very little likelihood of anything approaching a consensus emerging, either on the role of government in CE or the preferred policies regarding specific uses.

Throughout the policy process, governments have many mechanisms for facilitating expert input. Permanent mechanisms include the use of internal bureaucratic expertise, science advisors, offices of science and technology and science advisory councils, while temporary mechanisms comprise task forces, ad hoc committees, commissions, consultants, conferences, hearings and issues papers. Their remit can be specific to a particular application, such as DBS or tDCS, broader in scope across the range of brain intervention technologies, or, as illustrated by the President's Council on Bioethics in the U.S., cover a wide swath of issues. The U.K. Academy of Medical Sciences, for instance, recommended the establishment of regulatory authorities for cognitive enhancers, while the British Medical Association proposed a permissive system of regulation where techniques are permitted under license from a regulatory body, the Regulatory Authority for Cognitive Enhancements (BMA, 2007).

The role of the public in CE policy

In addition to dealing with immediate questions of safety and efficacy of various CE methods, there is a pressing need for pro-active policy founded on politically feasible goals. Even though the decision to use CE may be the individual's, the choices of individuals may impact collective behaviors and, in the aggregate, create social problems that require public engagement which listens to public voices (Forlini and Racine, 2009). What type of society do we want to leave for coming generations and where does CE fit into this? This is what the conflict between the transhumanists and the bio-conservatives comes down to in the end. In turn, it raises the question of what agency can best make anticipatory policy for society and what role the public should play.

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Although, as seen above, there are numerous mechanisms for incorporating expert opinions in the policy process, and special interests are likely to have ready access to policy makers, inclusion of public opinion is more problematic. If properly framed, public opinion polls, referendums and hearings can be a useful gage of public sentiment about an issue, but frequently they are captured by special interests, or advocates for one extreme or the other. Despite the difficulty of ascertaining public opinion, however, recognizing public attitudes towards CE is fundamental to the development of sound policy. While there have been some attempts to develop policy options for CE, and some governments have initiated policy debates and various commissions have issued reports, overall there has been minimal consultation with the public. Therefore, inclusion of the public in the CE debate is overdue (Fitz et al., 2014).

At the broadest level, the controversy over CE centers on a clash among public regulation, private regulation and no regulation at all. Although a government has ultimate responsibility for the health of its population, the dominance of the medical model and the power of the private sector have meant that a significant proportion of medical care, especially in the U.S., has remained the domain of non-public interests. In reality the range of regulatory options is more complicated than the public-private distinction suggests. Table 3.2 illustrates the range of options available for control of CE. Given its complexity, it is likely that a workable approach must involve some combination of these mechanisms.

Despite many factors that appear to justify a heightened governmental role in regulating CE services, public policies in medical matters remains problematic because rapidly advancing technologies and alterations in social values raise the prospects of instant obsolescence of any law no matter how carefully written. Legislation, in particular, risks freezing technology in place and might be unable to offer the flexibility needed to adapt to new applications. Furthermore, the moral underpinning of the debate over CE means that legislation could be made on the basis of emotions rather than dispassionate, rational choice. There is no guarantee that government involvement will be objective, nor helpful, in

TABLE 3.2 *Regulatory mechanisms*

	Individual clinicians	Professional association guidelines	Commissions, task forces, committees	Government guidelines	Government regulations	Statutory legislation	
Private							Public

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resolving the social issues and could even exacerbate them if viewed by either side as unfair.

Attempts to fit medical decision-making into models used for other areas of public policy also fail to account for several unique features of medicine. First, traditionally the conduct of medical decision-making has been based on professional judgments made without governmental intervention and monitored primarily by professional standards of care. A second special feature of medical decision-making, including CE, is its focus on the human body. As such, it is protected by constitutionally based liberties and the common law principle of self-determination (Blitz, 2010). Governmental intervention in the physician-patient relationship necessarily involves substantive decisions about medical care that can at times conflict with individual liberty and medical privacy. Bonnicksen argues that although there is a need for standard and systematic rule-making in medicine, where possible this is better served by a private policy model which 'views regularized rules and procedures in the medical setting as the desired end of biomedical decision-making' (1992: 54). To this end, Figure 3.2 illustrates the progression of processes that culminate in private policy manifested by professional society guidelines that are regarded as obligatory by those who practice in a given field.

While the debate at the practical level turns on whether a public or a private regulatory model is the most effective and feasible approach, at the conceptual level debate centers on the role of the public in a democracy. Should there be a role for the general public in CE decision-making, particularly if public funds are used in its research, development and use? It is useful to briefly examine this controversy as a struggle

FIGURE 3.2 *Progression of processes in private policy*

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between two democratic models, the technocratic elite model and the egalitarian model. The technocratic elite model emphasizes the democratic ends rather than the means of making the decision. A technocracy is controlled by technically competent professionals and assumes that modern problems require a degree of knowledge beyond the capacity of ordinary citizens and even their elected representatives. Experts alone have the interest and knowledge necessary to make informed decisions on these complex and largely technical issues. Moreover, the central role of professionals trained to make clinical decisions in medicine makes public control unfeasible. According to this model, to expand public control is to invite trouble because resulting decisions are bound to be uninformed and simplistic.

By contrast, proponents of the egalitarian model emphasize the importance of the means of making democratic decisions and call for broadened public control. They argue that the public is as qualified as experts to make policy decisions on issues that are as much social and moral as they are technical as illustrated by the extensive social and legal consequences of CE outlined in Chapter 2. This, of course, begs the question of what comprises the 'public.' Clearly, we do not mean a majority rule vote of all citizens as assumed in classical democratic thought. Most citizens really are not that interested or informed about any particular issue, a fact that technocrats use to defend their position. Pluralist theory assumes that individuals who are interested and informed in a specific substantive area will form interest groups that will effectively pursue their objectives through access to policy makers. A further assumption of pluralist theory is that the public interest is served by the resolution of conflict among contending groups. As interest-group politics has developed, particularly in the U.S., despite claims to the contrary that interest groups protect 'the public interest' or at least 'a public's interest,' overall reality falls far short of that pluralistic ideal.

Although there are still many proponents of democratic egalitarianism, it is more reasonable to define the effective public as composed of more or less specialized 'attentive publics' and their elected representatives. Although 'the attentive public' is that sector interested and informed in politics in general (Almond, 1950), there are more specific attentive publics formed around each functional area including science, neuroscience and even CE. Miller et al. (1980), estimated that the attentive public for science and technology was approximately 20 percent of the population although this must be viewed as likely inflated because

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the size of the public attentive to a specific issue depends on how broad its social impact is and how it is presented by the policy makers. For instance, the attentive public for CE will be narrower than that for neuroscience in general.

The goal of a democracy should be to expand each of these attentive publics to as broad a swathe of the general public as possible. Although public control here does not exclude a role for experts, ultimately the decisions are made by a broadened public under this position. Moreover, while public policy should not perfunctorily follow public opinion, a liberal democratic society should design regulations so that they 'reasonably align' with public attitudes (Fitz et al., 2014). Sarewitz and Karas agree that the immense potential opportunities and challenges of CE demand the engagement of as wide a variety of serious, informed perspectives as possible. 'It's not simply that the problem is too important to be left up to the experts, it's that we have no idea what expertise is going to be relevant. The practical question, then, is how to foster productive discussions in a society whose attention is notably fragmented and priorities are notably diverse' (2007: 21).

It is here argued that there is a need for conceptual clarification of the applicability of public control based on the distinction between making technical scientific decisions and determining broad social priorities. Figure 3.3 illustrates the interaction of this specialized-generalized continuum with the competing models of democracy. The weakest case for egalitarian democracy is in quadrant I. Continued low levels of scientific and technological literacy exhibited by the populace make it problematic that most citizens are either willing or able to develop a familiarity with the technical aspects of CE technologies. By contrast, technocrats have no valid claim to monopolize decision-making in quadrants II and IV, which are dependent on moral, not technical, competence. Expertise in a technical area does not ensure, and in some cases might even obscure, appreciation of and attentiveness to the social implications of CE. The kind of specialized knowledge experts have is not adequate in itself to deal with the unique ethical dimensions of CE centering on personal wellbeing, individual rights and the common good. Although experts, and this includes bioethicists as well as scientists, should be included in the debate over social priorities, and, in fact, might take a lead in a public debate, extensive public involvement is most critical here. The closer we approach full participation, the better for democracy in the end and the more likely a policy will succeed. As

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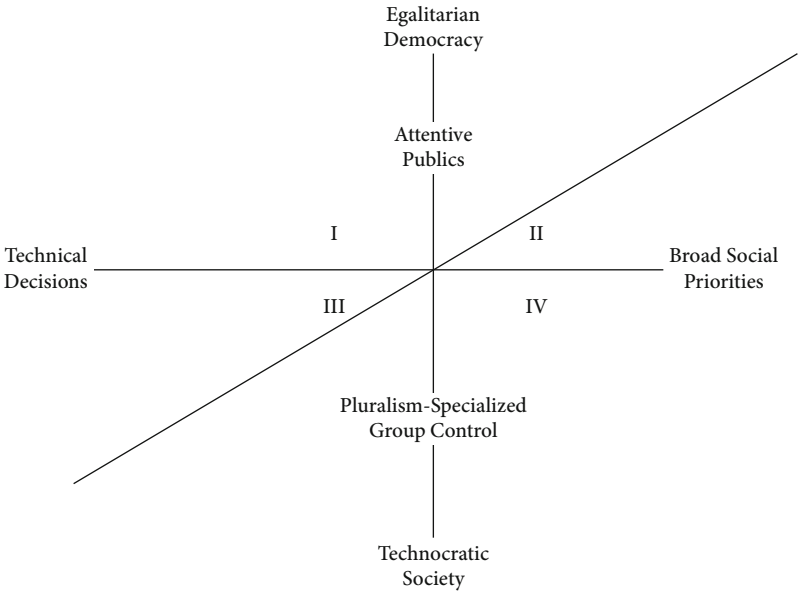

FIGURE 3.3 *Public role in policy making*

Makridis (2013) notes, until proponents of CE engage the public through democratic dialog, support is likely to remain isolated to small policy and government pockets.

Realistically then, quadrants II and III represent the focus in the debate over public participation in CE policy. The 45-degree line represents the optimal levels of public involvement in the various dimensions of CE. Although the size and quality of the attentive public should be widened at all levels, as we move from establishing broad social priorities toward making highly technical decisions, specialized groups progressively take on more importance. Thus, as we shift from deciding what the right ends of social policy ought to be to how specifically to carry out these goals, the scope of participation, of necessity, narrows. Even here, policy makers should ensure inclusion of all concerned groups, including those most vulnerable to potential misuse or coerced use of CE. In this regard, at least three professional bodies – the British Medical Association; the Commission de l'éthique de la Science et de la technologie du Québec; the American Academy of Neurology – have produced reports and guidance on CE (Outram and Racine, 2011).

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The Sandia report frames this tension between experts and the public somewhat differently, but in a way crucial to CE policy. They view it as a dispute between the ideals of scientific autonomy and the demands of democratic decision-making (Sarewitz and Karas, 2007). According to scientific autonomy, choices about what science does and how it does it must be left largely to the scientists. Any attempts to slow or divert science from the paths selected by scientists are usually misinformed and counterproductive. Moreover, because the future directions of scientific and technological advance are unpredictable, efforts to direct science along particular paths by democratic processes are inherently futile. Thus, scientific autonomy should be protected by insulating research from political interference.

The view that scientific enterprise should be free to pursue CE without political restrictions, however, is countered by strong arguments on behalf of democratic governance where the public has a legitimate voice in making collective decisions. Because CE could have profound effects on society and impact on all citizens, and because much CE research is supported by public monies, the public has a potential interest in the consequences of CE and should be the final arbitrator. From this point of view, scientists are an important source of technical information, based on their expertise, and can be an important interest group, but social issues require social solutions. Moreover, democratic processes, not scientists alone, should delegate decisions about distribution of public funds and organization of scientific research to a wide range of agents, including elected officials, bureaucrats and even the voting public. The report concludes that the boundary between scientific autonomy and democratic accountability will continually be negotiated and in constant flux. 'Because cognitive enhancement engages with the essence of human capabilities, it will appropriately remain a focus of democratic debate about the limits and prerogative of science for the foreseeable future' (Sarewitz and Karas, 2007: 13).

Setting a policy agenda for Cognitive Enhancement

The difficulties of policy-making for CE can be best understood if analyzed as part of a broader policy process. There have been many useful analyses of this process, which is usually presented as a series of stages or types of action. For example, Anderson (1990) envisions the

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process as consisting of five stages: problem identification and agenda setting; policy formulation; policy adoption; policy implementation; and policy evaluation.

In the problem identification and agenda-setting stage, an issue becomes a matter of public concern. Of the multitude of problems faced by society, only a small number receive public recognition, and even issues that are salient matters of public debate often fail to trigger governmental action. To explain why this happens, Cobb and Elder (1983) identify two agendas. The 'systemic' agenda consists of all issues that are commonly perceived by members of the political community as falling within the legitimate jurisdiction of existing governmental authority. By contrast, the 'institutional or formal' agenda is that set of items explicitly up for the active and serious consideration of authoritative decision-makers. Thus, the systemic agenda consists of general categories that define which legitimate priorities merit attention by the government, while the institutional agenda consists of those problems perceived as important by decision-makers that engender an effort to develop a course of action.

After an issue has reached the government's formal agenda, policy formulation begins. This is a complex process involving a range of actors inside and outside government, in which interest groups push for particular policies and attempt to influence priorities. Formulation usually includes analysis of various policy options, including inaction. Although policy adoption, which typically includes a legislative enactment or an executive directive, is usually the most salient stage of policy-making, policy formulation is the stage during which the boundaries of government action are defined. Once the policy is adopted, the focus shifts to the executive branch, which is responsible for implementation. Agencies make rules, adjudicate, use their discretion to enforce the rules and laws and maintain program operations. As soon as a policy is implemented, it is important to evaluate its impact. Evaluation entails comparing expected and the actual performance levels to determine whether goals have been met. It is also the stage in which the impact of new technologies on the existing policy can be assessed and appropriate adjustments in policy made to accommodate them. One question today is whether CE requires new policies or if existing policies can simply be adapted to deal with the issues it raises.

To be effective, a policy must progress through all five stages; however, the newness CE means that the most immediate attention must be

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directed toward agenda setting. Because there is always a multitude of issues competing for placement on the formal agenda, the fact that CE is controversial within the bioethics sphere and seems to be developing as a matter of public concern is no guarantee that policy makers will recognize it, consider it a political priority or put it on the formal agenda. Moreover, it is likely that some commercial interests will attempt to keep it off the public agenda to retain the unregulated status quo. The policy importance of a technological innovation depends both on the degree to which it provokes a public response and on how it is perceived by organized economic and political interests, which for CE are diverse.

There is a large literature on agenda-setting that is relevant to getting CE on the policy agenda of the various countries. A prominent work in the field is that of Kingdon (1995), who stresses the importance of timing and suggests that moving an issue onto or higher up on the agenda involves three processes: problems, proposals and politics. 'Problems' refers to the process of persuading policy makers to pay attention to one problem over others. The likelihood that a problem will rise up the agenda is heightened if it is perceived as serious by policy makers. 'Proposals' refers to the process by which proposed solutions are generated, debated and adopted. Typically, this process takes patience, persistence and the supporters' willingness to try many tactics. Framing a proposal in such a way that it is seen as technically feasible, compatible with policy-maker values, reasonable in cost and enjoying wide public support increases the chance of success. Finally, 'politics' here refers to political factors that influence agendas, such as the political climate and the actions of advocacy or opposition groups. While these three processes operate independently, the actors may overlap. For Kingdon, successful agenda-setting requires that at least two of the processes come together at a critical time, thus opening up a 'policy window'. Policy windows, however, are not just chance opportunities; they can also be nurtured. Furthermore, under the right circumstances, they can be seized on by key political players to move an issue onto the agenda. Baumgartner and Jones (1991) add that the image of the policy problem is crucial. If it is portrayed as a technical problem rather than as a social question, experts can dominate the decision-making process. By contrast, if the ethical, social or political implications of proposed policy are evident as in the case of CE, a much broader range of participants might be involved.

Agenda-setting in federal systems, such as the United States and Germany, is further complicated because policy-making can take place at

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the federal, state or local levels, with multiple agendas at play in multiple institutions at each level. A particular problem might be perceived and acted on by decision-makers in one institution at one level of government in one state but not be perceived at all, or be perceived differently, in others. Developments that would cause a particular issue to be placed on the government agenda, such as technological change, interest-group demands or even a widely publicized event, might be of limited interest geographically. By contrast, in highly centralized unitary systems like Britain and New Zealand movement to the national agenda can be more rapid when the conditions are favorable. As noted earlier, there already have been many official reports in response to CE in the UK.

A confounding factor for CE policy is the diversity of agendas among the myriad professional associations, commercial enterprises and individual practitioners in the private sector that have a stake in it. The agendas of the wide range of institutions and organizations in the public and private sectors may be in parallel or even overlap. As we have seen, the mass media can also play a significant role in getting issues recognized by policy-makers and, under the right circumstances, be decisive in pressuring them to act quickly in response to a perceived 'crisis.'

Although attention often focuses on public policy-making, as noted earlier, Bonnicksen (1992) favors increased emphasis on the private model because past governmental action has been 'premature, and unwise' in many areas of biomedicine. Although private policies have weaknesses, these can be partly remedied by political strategies. On the other hand, public policies are difficult to refine or revamp if found to be erroneous or misguided. At the very least, a private policy alternative warrants consideration for contentious biomedical issues such as CE. It is argued here, however, that while it is important that private-sector solutions be pursued where appropriate, the wide scope of issues emerging from CE and its broad implications for many societal groups make it a matter of public concern and, thus, public policy.

Also, it should be emphasized that policy-making, particularly in the U.S., is a gradual process, not manifested in quick, decisive action, thus any policy on CE is likely to evolve in fits and starts in a fragmented, unsystematic manner. Stakeholders looking for a quick response to an issue they personally view as paramount are often frustrated when policy makers fail to act swiftly. Moreover, most policy analysts agree that policy-making is not a textbook rational process but at best an

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incremental one in which analysis is limited to a small number of alternatives: the emphasis is on ills to be remedied rather than on positive goals to be met and the analysis of future consequences is scant. Since CE is largely viewed as an emerging future issue and not a crisis, it is not likely to engender much attention by policy makers, no matter how important it seems to stakeholders or bioethicists. Moreover, under the incremental model, new policies usually do not vary substantially from past ones, meaning that novel areas like CE have a difficult time penetrating the process inertia.

Conclusions

The mounting attention accorded CE in the media has precipitated awareness of its potential importance to individuals and a small attentive public, but it has not yet placed it on the policy agenda, even within the health-care arena. The impending ramifications of CE for society summarized in Chapter 2, however, suggest this situation will change and pressures will intensify for fair and workable CE policies. On a wider scale, the political debate surrounding the expanding knowledge about the brain and new intervention techniques, including CE, promises to be intense. The wide array of new intervention capacities and the tremendous costs of CNS-related health-care problems, along with the coalescing view that the mental and physical dimensions of health are inseparable, will elicit considerably more attention from policy makers in the coming decades. At the least, this analysis demonstrates the pressing need for more methodical and pro-active investigation of the social consequences of the rapid diffusion of these impressive, often dramatic, innovations as neuroscience slowly moves onto the public agenda.

Obviously, one's stand on the four ethical frameworks discussed above will impact directly on their acceptance or rejection of specific enhancement policies, on the type of government activities, if any, they support from Figure 3.1, and on their support for an increased role of the public. For those with a laissez faire approach, the trump card is held by each user: permissive/encouraging social policies, if any, are favored. Managed technological optimism and skepticism advocates accept varying degrees of intervention to protect individual users and the broader society, with the former oriented toward 'encouraging' policies and the latter toward 'discouraging' and regulatory policies. By contrast, human

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essentialists of assorted persuasions are likely to back strict constraints on CE, including prohibitive policies. Chapter 4 offers a preliminary assessment of the policy needs of the various methods of CE using a managed technological skepticism perspective.

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4

Framing Cognitive Enhancement Policy

Abstract: *This chapter presents an admittedly speculative policy approach to dealing with the wide array of potential enhancement interventions. It also discusses the need for dedicated research on CE, especially CE devices. It argues the need for medical technology assessment of CE techniques that include analysis of long-term, second-order consequences, both positive and negative. It then examines what, if any, boundaries of social justification there are for mandatory use, economic incentives, licensing, disincentives or prohibition of cognitive enhancement technologies.*

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As outlined in Chapter 3, all governments have a wide array of actions they can take to deal with the issues raised by CE. It also demonstrates, however, how difficult it will be for CE to enter the public agenda, particularly given the disparate assortment of CE techniques and the tenuous line between traditional medical treatments and enhancement. Clearly, each CE drug or technique has unique characteristics; any policies that fail to recognize this will be unworkable. Therefore, when framing CE policy, it is essential to be flexible enough to distinguish among the numerous, and ever growing range, of potential CE approaches. Each technique, therefore, should be assessed based on its own merits. This, however, does not negate broader technology assessments of the concept itself and research on to long-term impact of CE on society, both positive and negative.

Table 4.1 presents a tentative framework for examining each proposed CE technique as to safety, risk and efficacy for the individual. Although it is highly provisional and certainly open to dispute over the specifics, it illustrates that each putative enhancement method should be assessed

TABLE 4.1 *Comparison of Cognitive Enhancement techniques*

	Efficacy	**Risk/Safety**	**Provisional policy**
Computer brain games	Mixed evidence on far transfer	Low risk	More research on long-term benefits. Consumer protection
Neurofeedback	Mixed evidence on far transfer	Moderately safe, Low risk with responsible use	Regulate marketing and product safety
Modafinil	Evidence of effectiveness	Low risk with responsible use	Allow prescribed CE use with controls
Methylphenidate	Mixed evidence of effectiveness	Risk of abuse and dependency, long-term effects unclear	Discourage use. Regulate closely, more research
Amphetamines	Mixed evidence of effectiveness	Commonly used but high risk of dependency, heart issues and abuse	Prohibit enhancement use at this time, more research
AChEIs (donepezil)	Mixed evidence	Unclear for CE use	More research needed on use for CE
Beta-Blockers	Evidence of effectiveness	Low risk with responsible use	Allow prescribed CE use with controls
'Smart drug' supplements	Little credible scientific evidence	Long-term effects unknown but probably low risk	Regulate marketing and product safety

Continued

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TABLE 4.1 *Continued*

	Efficacy	Risk/Safety	Provisional policy
tDCS	Mixed evidence of effectiveness	Relatively safe procedure but long-term consequences unclear. Heightened risk outside of professional use.	Licensed use, more research on long-term safety. Regulate marketing of do-it-yourself tDCS for product safety
TMS	Mixed evidence of effectiveness	Some risk of seizures and long-term consequences unclear	Regulate closely, more research on long-term safety
DBS	Mixed evidence of effectiveness	Possible major side effects and risk of complications of surgery	Prohibit based on risk grounds, more research on safety and long-term effects
BCI	Unknown	Very early stage of development but relatively invasive procedure with risks higher than DBS	Prohibit enhancement use but allow research on potential enhancement uses
Nano-biotic devices	Unknown	Unknown	Early stages of research
Gene therapy	Unknown	Unknown	Early stages of research

on its own strengths and weaknesses. Importantly, this summary does not address the broader social concerns that were raised earlier which must be dealt with through mechanisms such as national committees or commissions or through studies such as that conducted by the Office of Technology Assessment at the German Bundestag (Coenen, 2008). Also, it assumes a managed technological skepticism perspective which errors on the side of caution before countenancing the use of these drugs/procedures for enhancement purposes.

Need for dedicated research on Cognitive Enhancement

One obvious conclusion from the table is that virtually all CE techniques require substantially more focused research to assess the safety, efficacy and advisability of allowing healthy individuals to use these techniques for enhancing their cognitive functions. Although the ethical debate over CE

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is principally a normative undertaking, it must be informed by neuroscientific research to supply empirical facts (Maslen, Faulmüller and Savulescu, 2014). Moreover, there is a distinct need for expanded interdisciplinary research among the medical and social scientist communities, in order to provide better data for evaluation of potential demand and use of CE. While research might demonstrate that the risks for certain techniques are sufficiently low to warrant the pursuit of a more active CE governance involvement, further research is needed to understand the bounds of uncertainty, both in terms of magnitude and length (Makridis, 2013).

The most pressing research need, which has been found to be lacking for most putative CE techniques, centers on determining their safety and efficacy. Forlini et al. (2013) conclude that before even considering bans or regulations, society must address two crucial questions: Are these drugs safe and do they work? To answer these in a satisfactory manner, however, will require either clinical trials on CE safety and efficacy, or, minimally, longitudinal health surveys to monitor for adverse side effects of CE use. Both of these require substantial financial resources for studies of something that is not a health issue per se. Also, more research on the risks of dependency from CE is urgently needed before widespread use. Data of this kind are crucial for discussions about regulation even though requiring this research will provoke criticism from those strong promoters of CE who will view it as a delaying tactic.

In the U.S., in addition to clinical testing the FDA performs scientific assessments analyzing some CE techniques, and through their ten-year outlooks it advances and restricts types of technology and socio-political-economic contexts, largely based on the medical model (Herman and Devey, 2011). To supplement this limited research, in addition to longitudinal studies investigating the long-term safety profile of potential CE techniques, Maslen, Faulmüller and Savulescu (2014) recommend identification of the effects of CE in targeted and specified populations (such as those who are least well off), investigation of the functional trade-offs associated with different types of CE, and research on a 'personalized enhancement' approach to help us understand what effect any particular CE technique might have on a specific person. A principal goal of this multifaceted research should be to establish how permissible CE use is and how society and regulatory bodies might best respond to it. While some of the issues surrounding CE are predominantly political (e.g. coercion, distribution and access) and others are largely metaphysical (e.g. authenticity and

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naturalness), their resolution has much to gain from focused CE research. As noted above, in addition to resolving some of the unknowns surrounding safety and effectiveness of various CE techniques, there is also a need for concentrated social research concerning the use of CE for individuals, as well as society at large. Thus, technology assessment is discussed later in this chapter after examining the challenges connected to the research needed to test CE drugs and devices.

Protocol for CE research

To date, there has been little discussion about how current ethical norms and legal rules to govern the use of human subjects would apply to CE research. When mentioned at all in the literature, enhancement research, as opposed to research aimed at diagnosing, preventing or treating illnesses or medical conditions, is usually dismissed without explanation (Mehlman et al., 2011). As Mehlman and Berg (2008) suggest, there are two critical steps in determining whether a medical experiment involving human subjects can be conducted in an ethical manner: (1) assessing risks and potential benefits and (2) obtaining potential subject's informed consent. Although the FDA has approved medical indications for many of proposed drugs used for CE, none of them have been subjected to formal clinical investigation or approved specifically for enhancement uses. Thus, physicians who provide access to them for such purposes must do so on an off-label basis. But the increasing demand for enhancements that are safe and effective, coupled with FDA impediments on marketing products for off-label uses, suggests that some manufacturers may become interested in sponsoring full-scale clinical trials in order to obtain licensing approval for enhancement indications. Furthermore, physicians might pressure the National Institutes of Health (NIH) to fund more enhancement studies in order to generate information that they can use in advising their patients. It should also be noted that research programs and use of enhancement drugs in the military has implications for the general population, particularly since it does not adhere to the same regulatory scheme. Although the military review and approval processes are more thorough, their criteria are significantly different. However, once the military allows off-label use for CE, it would be hard to call for a ban on their civilian use (Makridis, 2013).

Although health-oriented and enhancement research is likely to be similar in many ways – employing the same basic steps to minimize the risk to subjects and maximize the benefits, and using similar

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methodologies – the introduction of new forms of CE complicates this problem: the current regulatory process is hard pressed to accommodate the inevitable complexity. In particular, the FDA would need to test drugs for an entirely new subset of the population, namely individuals that are already healthy (Makridis, 2013). One question raised earlier is whether the benefit from an enhancement is inherently less valuable than a health-oriented intervention. On the one hand, it might appear that medical benefits are inherently more valuable than enhancement benefits. Moreover, if enhancements have less inherent value than therapies, then it would seem unethical to expose enhancement subjects to the same amount of risk as research subjects. Also, since enhancement subjects are healthy to begin with, they might have more to lose: researchers should offer them greater benefits for a given amount of risk. However, while it seems reasonable to expect that some health-oriented benefits would be regarded as more valuable than some enhancement benefits, the latter may be perceived as more valuable than the former. For example, a CE that increased cognitive function substantially could be considered more valuable than a substance to treat a minor skin irritation (Mehlman and Berg, 2008).

An additional way in which the assessment of risks and benefits in enhancement research differs from therapeutic research is that CE, itself, provokes far-reaching social and ethical objections, such as that it is unnatural, interferes with authenticity, or exacerbates social inequalities, that might lead to greater skepticism in assessing potential benefits and in offsetting them against risks. Mehlman and Berg (2008), however, contend that these same objections can also apply to research leading to effective therapies insofar as treatments and preventions also interfere with the natural state and can result in health disparities based on race and income.

Another research issue has to do with identifying the information that needs to be included in the consent form. Are people who participate in enhancement research more like healthy volunteers or like ill participants? Although they are not medically vulnerable in the same way as ill patients, neither are they comparable to healthy volunteers who participate in research for altruistic reasons or compensation. How, then, should the investigator describe an enhancement benefit and explain the risks to the subjects? Moreover, while regulations are clear that Institutional Review Boards (IRBs) should not consider the possible future effects of applying knowledge gained by a research project, there are no specific guidelines on how and whether to discuss

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non-medical risks with the participants. Alternatively, there might be a tendency of investigators and IRBs to medicalize enhancement benefits by categorizing them in terms of therapeutic benefits to better fit the traditional research framework.

There is no shortage of interests surrounding CE technologies that would benefit from more research funding. As discussed earlier, the Pentagon DARPA program has been active in CE research from the beginning. In addition, the NIH has substantial funding – primarily for cognitive therapies for dementias, and so on. – while the National Science Foundation funding for CE in 2011 was approximately $10 million. Moreover, most every major research university has ongoing research in various areas of CE. In the private sector, seven of 90 current projects at Pfizer, totaling about $500 million, three of 120 projects at GlaxoSmithKline, at about $200 million, and lesser amounts at non-profits, including the Cure Alzheimer's Fund, involve CE (Makridis, 2013). Cumulatively, these forces, along with the burgeoning commercial sector on the Internet, illustrate the strong financial influences motivating the expansion of the CE industry.

Despite the potentially large range of both public and private funding sources, research focused on CE remains constrained. Academic research continues to be hindered by the disease framework, under which it is difficult, at best, to secure funding to study putative cognitive enhancers except in contexts where the study can be linked to some recognized disease. As a result, public funding for CE research does not yet reflect the potentially vast personal and social benefits that could accrue through the development of safe and effective enhancers (Bostrom and Roache, 2009). Funding decisions about research projects are typically made through a combination of open, bottom-up, investigator-initiated competitions or through strategic, top-down funding in specific areas that are identified as priorities. Since few funding programs specifically support enhancement research, for example, the DARPA program on 'augmented cognition', funding for CE research is most likely to come from general research funding mechanisms, where it must compete with other priorities for strategic funding. Some observers condemn the scarce resources currently devoted to CE research (Heinz et al., 2012), but as demand for CE grows, funding agencies might be more inclined to provide such funding. Also, funding for CE research could find mounting support on the grounds that it promises to increase economic prosperity in aging nations with struggling economies to augment their 'mental wealth' (Kirkwood et al., 2008).

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Existing practice also tends to approve funding for basic research if and when it could quickly help those with the most severe health conditions. These prioritizations would not work in the realm of enhancement for three reasons: a traditional approach to funding research would tend to leave most enhancements on the theoretical drawing board; unless research can be seen as incurring therapeutic benefit against an identified disease or medical condition support for broad scale research and translation of outcomes and products concerning CE will be lacking; finally, even with a growing market for certain CE methods, it is difficult to generate the funding necessary to support and sustain the exploratory research required for translation to safe commercial technologies (Shook, Galvagni and Giordano, 2014). Moreover, as Forlini et al. (2013) warn, because the research process involves many steps and stakeholders – including funding bodies, researchers, drug companies, government and research ethics committees and clinicians – it is hard to see how the diverse interests of these stakeholders could be integrated to support a specific position on CE research.

Medical technology assessment

In order to assess the long-range impact of CE, short of creating a new agency or authority similar to that instituted in the UK for reproductive technologies, efforts of technology assessment and forecasting need considerable strengthening. Technology assessment has been defined, alternately, as: (1) a narrow technical analysis of the risks and benefits of a technique, or (2) an inclusive broad assessment of the interplay between technology, social values and social institutions. Although, as discussed above, technical assessments are essential for evaluating options for the application of each CE technique, given the interactive and complex nature of CE issues, adequate estimation must include the ethical, social and policy dimensions as well. The Institute of Medicine defined medical technology assessment (MTA) as the 'process of examining and reporting properties of medical technology used in health care, such as safety, efficacy, feasibility and indications for use, cost, and cost-effectiveness, as well as social, economic, and ethical considerations, whether intended or unintended' (1985: 2). This definition raises two aspects of MTA which are crucial to its full effectiveness: most obvious is the broad concern with the effects on society; more subtle is the emphasis on second-order

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consequences – those which are unintended, indirect or delayed. Any assessment of CE technologies or proposed programs to be built around them must focus on both of these concerns as well as on the strictly technical questions of safety and efficacy.

There are many monikers for assessment approaches used to investigate health technologies that are carried out in the private and public sectors. Among them are: medical technology assessment (MTA); health impact assessment (HTA); social impact assessment; and, participatory technology assessment (Wolbring et al., 2013b). The former term MTA will be used here. The history of MTA, in the U.S. at least, has been an inconsistent and controversial one. On the one hand, it has been characterized by passionate opposition from interests that perceive it as a threat to their autonomy; on the other, detractors feel it has failed to accomplish the objective of critical assessment and stem the proliferation of questionable technologies and procedures. Moreover, many contemporary MTAs have been narrowly focused and rarely entail the collection of primary data, depending instead on syntheses of secondary sources often supplied by the medical industry. Also, because each organization has a stake in the results of its assessment, they often can be less than objective. Therefore, the TA process is fraught with political landmines. For instance, in the early 1990s, after conducting numerous TAs, including four reports on neuroscience research of which the author was an Advisory Board member, in the early 1990s Congress abolished its Office of Technology Assessment (OTA) on political grounds.

It is understandable that MTA has had opposition from many forces within the medical industry. Because assessment takes a considerable time to do well, in the least it threatens to delay new technology applications and dampen potential profits. Moreover, any MTA that would dare recommend stopping or slowing development of particular CE innovations faces criticism from those individuals, interest groups and economic interests that have a stake in it. Ironically, in the past such opposition has been a factor in shaping MTA efforts such that they are largely ineffective in curbing the proliferation of medical innovations. In turn, this has triggered criticism from observers who believe that MTA is bound to fail because it does not challenge assumptions of the medical model and the technological imperative. The strong preference of the public and leaders for increasingly advanced biomedical interventions, such as CE, thus makes any attempt to restrict their development politically unattractive. For instance, according to Callahan, the TA movement

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is just another example of the faith in technology fixes for complex social problems because it lacks any real value framework by which to make judgments on the moral or social worth or value of different technological goals (1990: 92). Also, because of the inherent difficulty of MTA to deal with futuristic problems, they are often downplayed. Whether because of short-term political pressures, the difficulty of forecasting long-term problems, or some combination of the two, the time frame of many MTAs continues to be limited to the near future.

The complexity of the interaction between CE and values requires considerably more attention to the long-term power of the technologies to alter values, often in unanticipated directions. Unfortunately, much of the current MTA tends to be linear in nature with little appreciation of the interrelationships and dynamics of the technology, politics and values. Thus, it tends to underestimate technology's impact on public expectations and usage and vice versa. The burdens, or advantages, that these technologies may present future generations and the social consequences that might accompany them tend to be minimized or ignored in many assessments. As a result, current mechanisms for oversight of technologies are clearly not capable of capturing and addressing possible future social outcomes of research (Forlini et al., 2013). It is important to note that these decisions could cut both ways regarding the future. For example, Sarewitz and Karas (2007) ask whether decisions of today's humans to restrict or reduce the enhancement of future generations unjustly interferes with a future generation's right to maximize its capabilities. Similarly, assessing the potential risks of various types of CE, and recommending how to respond to them, requires accounting, not only for what harm might accrue, but also for the potential benefits it might offer. A more constructive approach would focus, not only on anticipating potential harm and benefits, but also on identifying potential supporting policies and practices that could alter the balance for the better (Bostrom and Roache, 2009).

The multifaceted issues raised by CE also explain the difficulty of creating dispassionate panels of diversely trained individuals at the national and, much less so, at the international level. There seems to be an unstated assumption among some bioethicists that consensus can be reached on broad principles within which the specific issues can then be resolved. However, in pluralistic societies with sensitivity to diversity, this kind of consensus seems unlikely. Therefore, while it might be tempting to call for national (or international) CE-focused advisory

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bodies, there are pitfalls to centralization where a capture by political interests might be accompanied by the dependence on a small cadre of experts who are presumed to speak for a more diverse community of persons many of whom, deliberately or not, are left out of the influence loop. If policy makers create a national advisory body on CE, for instance, they might well view it as *the* authoritative voice on the issue. There is little evidence to inspire confidence that a national commission or analogous body would deal effectively or fairly with the issues raised by CE. Moreover, how can such a body be guaranteed sufficient autonomy to insulate it from political pressures, both in defining its mandate and agenda and presenting its outcomes? As evidenced from many bioethicists' responses to the President's Council on Bioethics, one must question how enthusiastically its findings would be received – even by the broader neuroethics community, much less a skeptical public.

Ongoing policy issues in Cognitive Enhancement

According to the Nuffield Council on Bioethics, requiring evidence of the benefits of any new technology, particularly in the clinical domain, is common to assessment of its overall permissibility. However, while the risks and side effects of enhancement techniques can be assessed similarly to their clinical applications, it is less clear how their benefits should be measured. Unlike clinical interventions, the benefits of enhancement technologies are idiosyncratic and dependent on the goals, values and specific circumstances of each individual. While still imperative that potential consumers are thoroughly informed about the risks and efficacy of enhancement products, the valuation of benefits and the weight they are given is probably best made by the consumer (Savulescu and Maslen, 2013). Therefore, the current medical risk system that compares treatment risk with the expected benefit of reduced morbidity risk from successful treatment is risk averse for enhancement. Bostrom and Sandberg (2009) note that cosmetic surgery offers a precedent for a risk model where patient autonomy take priority over at least minor medical risks even when the procedure does not reduce or prevent morbidity.

As noted earlier, the role of professional medical associations and medical practitioners is pivotal to all types of CE, especially physical interventions. Miller and Brody (2005) argue that the distinction between treatment and enhancement is relevant to the ethical consideration

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of professional integrity. They suggest two principles for justifying or prohibiting clinical involvement in CE from this perspective. First, the more clearly an enhancement can be understood as serving a legitimate medical goal, the more easily it can be justified. Second, the greater the risks involved in the enhancement intervention, the more difficult it is to justify it in the absence of a clear health rationale (also Forlini et al., 2013). On these grounds, the risk of permitting drugs like methylphenidates and amphetamines as legally available commodities for the healthy population are questionable. Given their effects on the dopaminergic pathways in human CNS, they have considerable side effects, ranging from drowsiness and insomnia to addiction, increased blood pressure, serious cardiovascular problems and even sudden death. Although MPHs appear safer than amphetamines, Ritalin has been linked to both physiological and social harm. On these grounds, LaBuzetta (2013) suggests we must look for other forms of enhancement drugs.

However, if, after more extensive research and proper assessment, prescription drugs such as Ritalin, Adderall, modafinil, the AChEIs and any others are approved specifically for CE, there will still be continuing issues surrounding their use, supplier authorization and possession that must be addressed before they are made available for enhancement. For instance, should cognitive-enhancing drugs be procured by prescription only or with over-the-counter availability? If not by prescription, are there any controls over how much of each substance an individual is allowed to have in their possession? Where can it legally be sold? Who pays for the CE drug? Although there is no evidence of public funds being allocated for enhancement purposes at this time, if they become legally available in the litigious U.S. it is only a matter of time before lawsuits are filed for access to public-funded enhancement services.

Although regulating nootropic drugs will entail modifications of the existing disease-centered regulatory framework, other techniques listed above require even more innovative policy approaches. The current expansion in direct-to-consumer advertising and marketing and sales of CE drugs and devices, including fairly innocuous ones such as computer brain games, calls for greater governmental regulation for consumer protection and public safety (Hanrahan, 2013; Racine, van Der Loos and Illes, 2007). As presented in Chapter 2, the persistent, high-powered marketing of natural brain supplements on the Internet, through email solicitation, and on TV celebrity 'doctors' shows represents a clear policy challenge. While the FDA has established detailed boundaries for drug

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advertising per se, currently there are completely deficient formal regulations for controlling natural supplement marketing.

Similarly, the commercial development of CE devices (CEDs) deserves greater regulatory attention. Maslen et al. (2014) argue that the regulatory gap for CEDs is especially troubling, given that these potentially risky devices are progressively being produced and marketed online and being bought and used by individuals, who have little knowledge and training, outside of a clinical setting. Dubljević (2014) adds that the unclear regulatory environment surrounding CEDs is already being commercially exploited. Emphasizing that tDCS is not without safety concerns, Fitz and Reiner (2013) have also called on regulators, scientists and the tDCS community to develop policy proposals that ensure public safety while, concurrently, supporting do-it-yourself innovation. Although most medical devices have to undergo rigorous clinical assessment before being approved for placement on the market, despite posing risks in a similar way to medical devices, in most countries CEDs do not have to meet anything more than basic product safety standards. For instance, since CEDs are neither diagnostic nor therapeutic, they are not identified as devices for medical regulation in the UK (Maslen et al., 2014). Although the lack of a rigorous regulatory process for these devices has been addressed in reports of groups including the British Medical Association (BMA), the European Commission and the Academy of Medical Sciences, there has been little overt guidance to lawmakers and regulatory bodies on the regulation of CE technologies (Outram and Racine, 2011).

In their seminal study, Maslen et al. (2014) present eight regulatory options for CEDs and reject the last two, the status quo and prohibition, out of hand.

1–3. CEDs could be regulated via a new process specifically for CEDs, to: a higher regulatory standard than medical devices, a lower regulatory standard than medical devices, or the same regulatory standard as medical devices.
4–6. CEDs could be regulated under the same legislation as medical devices, to: a higher regulatory standard than medical devices, a lower regulatory standard than medical devices, or the same regulatory standard as medical devices.
7. The status quo could be maintained.
8. CEDs could be prohibited.

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After analyzing the remaining options, Maslen and colleagues (2014) conclude that the best option would be to accommodate CEDs within the existing regulatory process for medical devices. Moreover, given their personal inclination to promote consumers' freedom-to-choose, they suggest that consideration should be given to incorporating a 'low-risk exemption', whereby any device that falls beneath a given level of risk would be approved whether clinical assessment confirms any consistent objective benefits or not. Devices posing a risk greater than this low-risk threshold would have to demonstrate objective benefits, although in cases where it is contested whether these make the risks acceptable, the device should be approved but with a requirement for manufacturers to provide transparent, detailed, evidence-based information pertaining to the mechanisms, risks and effects of the devices.

A series of responses to their article led to a refinement of their model (Maslen et al., 2015). Kuersten and Hamilton (2014) first responded that the regulatory gap, in Europe at least, is not as dire as implied and disagreed with their method of assessment which requires that both risk *and* benefit be considered when defining categories of regulatory oversight and object that devices with low risk need not prove benefit and are exempt from continuing regulation. While the authors claim that they can assess benefit through measurement of 'wellbeing', Kuersten and Hamilton contend that consumers are the best assessors of what is beneficial to them. Thus, it is overly paternalistic for states to dictate to individuals the benefit of a product on the general market, and then use this unilateral judgment to determine acceptable risk associated with it. On the other hand, De Ridder, Vanneste, and Focquaert (2014) suggested that medical device regulation might create the 'illusion' that devices are actually beneficial. Fitz and Reiner (2014) largely support Maslen and associates' claim that the regulatory framework for medical devices should be extended to include CEDs, but King, Gavaghan, and McMillan (2014) warm that when users are determined to use devices in a risky way, they will do so despite safety standards.

One interesting take on the need for regulative policy is offered by Dubljević (2015). Although most proponents of regulation emphasize safety and efficacy concerns, he focuses on undesirable long-term social ramifications. If modafinil is not regulated appropriately, he argues, it might produce an overall increase in shift work; which, in turn, could produce significant health-related and social costs. This is because the availability of modafinil may offer a perfect excuse for

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employers to increase expectations and overwork the unprotected population of the least advantaged by requiring them to use the drug. Since research shows that a steady increase in social problems can be expected as working hours increase, detrimental effects on the basic structure of society and the prospects of future generations could ensue. Paradoxically, the short-term cognitive enhancer modafinil might lead to an overall long-term decrease of cognitive ability in disadvantaged populations in society. Instead of helping to alleviate problems, modafinil could, therefore, exacerbate the problems facing the population at large.

Although Bostrom and Roache (2009) contend that individuals are usually best positioned to decide for themselves whether and how to enhance, even they see the need for some degree of paternalism to protect users from at least the highest risks. To deal with this tension, they suggest a policy that establishes a baseline level of acceptable risk for approved interventions. This could be accomplished through comparison with other lifestyle risks that society allows individuals to take, such as risks from smoking, mountain climbing or skydiving. Enhancements that could be shown to be no more risky than these activities would be allowed, with appropriate information and warning labels.

Conclusions

This discussion of the impact of research on the CE debate takes us back to the definition of CE in Chapter 1, particularly the distinction between CE therapy and the more narrow definition of CE for healthy individuals. No matter how one views the latter, research on these drugs and devices will be driven by the former. There is too much to gain in the fight against dementia, schizophrenia, addiction and other disorders to ignore the cognitive benefits they might provide. But once they are available for CE therapy, diagnostic creep and the use by healthy people for enhancement are unavoidable. The same holds true for brain stimulation methods.

All governments have a broad range of powers that could be applied to specific emerging techniques and drugs that have potential CE uses. Although, to date, most attention has focused on the scientific and ethical dimensions of enhancement, not public policy, this is likely to change as the policy implications for individuals and societies are crystalized. Moreover, as the issue of enhancement becomes more salient, various

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groups are likely push for government involvement to further their own interests and perspectives. As discussed in Chapter 3, the form of government response to any technique can, hypothetically, range from mandating to prohibiting particular research or applications, although it is more apt to take a more nuanced regulatory form.

Although it is too early to speculate how divisive the issues surrounding CE ultimately will become and when and how they will reach the policy agenda in a particular country, this chapter demonstrates a pressing need for systematic research on the safety, efficacy and risk components of the each of the various techniques *before* widespread use. Moreover, it is essential that an expanded dialog should include an assessment of the longer-term ramifications for society which address the broader ethical concerns discussed in Chapter 2, as well as other issues that are certain to arise; for example, neuroscience, nano-biotic and other technologies.

As the policy issues surrounding cognitive enhancement unfold, one might look toward smaller, more homogenous countries such as Denmark, The Netherlands or New Zealand, or highly centralized political systems such as Britain, for workable regulatory frameworks. Alternately, innovative policies might emerge from individual states or provinces such as Quebec or New South Wales. Given the fragmented U.S. system where constitutional rights will likely negate controls over individual use of many techniques, it is doubtful that substantial anticipatory policy initiatives in CE will be forthcoming. Sarewitz and Karas (2007) suggest that different nations may adopt very different approaches to governing CE. Some democratic nations might decide that the ethical challenges raised by CE warrant strict regulation while others may be more permissive. Although this is undoubtedly true, the presence of an international market for CE products on the Internet will make country-specific policies, at best, difficult to implement, particularly any attempts to prohibit or strictly regulate CE drugs and devices. By contrast, just as individuals might feel effectively coerced into participating in CE to avoid discrimination, so democratic nations could decide that they need to aggressively pursue enhancement technologies in order to maintain a competitive position, resulting in a new sort of CE arms race.

History demonstrates that many public concerns over novel technologies that threatened the status quo in the past no longer troubled the vast majority of citizens once these technologies were perfected (Turner and Sahakian, 2008). Similarly, Bostrom and Roache (2009) speculate that the heated current controversy surrounding unconventional means of

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CE is due largely to the fact that they are new and experimental instead of to any problems inherent in the technologies themselves. As we learn more about the strengths and weaknesses of these CE methods through research and practical experience, public acceptance is likely to increase. This change will be accelerated: by strong commercial interest in CE, by direct-to-consumer marketing of CE products, and by an enthusiastic media. Eventually, the debate over CE is likely to be absorbed into the normal discussions about the merits and demerits of various kinds of technologies, medicines and practices and the unconventional will become conventional (Bostrom and Roache, 2009). As well stated by Wolbring and colleagues:

> We believe that the perfect storm of CE technologies, the shift in ability expectations toward beyond species-typical body abilities, and the increasing desire of health consumers to shape the health system will increasingly influence various aspects of health care practice, policy, and scholarship and that now, at this early stage, is the time to gain a good understanding of what drives the push for the enhancement agenda and enhancement-enabling devices, and the dynamics around acceptance and diffusion of CE. (2013b)

In summary, although Trachtman (2005), Kipke (2010) and others might be correct that the debate surrounding CE has exaggerated its importance and that demand will never be as large as some project, many factors presented here suggest otherwise. Admittedly limited evidence indicates that the aging Baby Boom generation is concerned about diminishing cognitive function and represents a huge, lucrative target for a range of CE drugs and techniques, especially computer brain games and natural supplements that promise to maintain, restore or enhance brain power. Moreover, the younger generations, whether students or professionals, raised in an increasingly competitive and biomedicalized society with a technological fix mentality, are also likely to pursue products that promise enhancement for themselves or for their children, even if the scientific evidence of their effectiveness is lacking, but even more so if and when proven methods are found. Whatever the future holds in terms of demand and prevalence, however, now is the time to widen the policy dialog on CE and initiate or expand research and assessment activities as outlined above. Only then can society decide how to frame public policies to effectively manage the emerging issues that CE engenders.

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