Research and technology for learning and memory

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Enhanced Learning

Technological advances in bioelectronics and applied neural control technologies have enabled scientist to create machine assisted minds (McGee & Maguire, 2007). The technological advances have been sought to improve the quality of people's mental capacities by enhancing one's ability to learn just like pharmaceutical enhancements have done in the past (McGee & Maguire, 2007). However, when enhancing ones' mental abilities as both technological and pharmaceutical advances have done, many ethical questions arise. This paper will address the available and future plans for learning enhancements and ethical implications for learning enhancements such as; pharmaceutical enhancements that are acceptable and controversial, uses of brain/ computer interfaces, equal availability of brain enhancements to all diverse groups, who controls how brains are enhanced, and who receives enhancement. These topics will be further explored by this author's ethical viewpoint.

When one talks of brain enhancement certain images from futuristic movies displaying cyborgs may come to mind. However brain enhancements specifically for learning are nothing new. Doctors for many years have been prescribing pharmaceuticals to enhance one's ability to teach (McGee & Maguire, 2007). These drugs promise to improve general psychological and cognitive functioning by enhancing ones' mood, memory, attention, alertness and other cognitive capacities (Fuchs, 2006).

Increasing one’s ability for attention and alertness has been accomplished over the last two decades through psychostimulants such as methylphenidate and dextromphetamine (Fuchs, 2006). The legal drugs have been used to treat (ADHD) and enhance attention and other functions in healthy people (Fuchs, 2006). Another drug that has been reportedly used on mood and personality in healthy people is the use of selective serotonin inhibitors (SSRIs) (Fuchs, 2006). Healthy individuals who take (SSRIs) in absence of mental illness have frequently reported that negative feelings such as anxiety, sadness, disappointment, guilt or shame are weakened and self-esteem and confidence rise(Fuchs, 2006). In addition (SSRIs) may be attributed towards giving individuals a sense of well-being and offer positive influence on the quality of individual’s social interactions (Fuchs, 2006).

Pharmaceutical development in increasing ones’ ability to recover memories and block memories is currently in the works for future development (Fuchs, 2006). The pharmaceutical uses for recovering memories will be specifically targeted towards those who are cognitively impaired by the aging process and for those who develop dementia (Fuchs, 2006). The pharmaceutical development in blocking memories will be developed specifically towards blocking painful memories in those who suffer from PTSD (Fuchs, 2006).

Ethical considerations in dealing with the use of pharmaceutical enhanced cognitive abilities stem from improper diagnosis and misuse. The implications for methylphenidate and dextromphetamine drug misuses come from improper diagnosis. For instance, how can one surmise that a problem with a child’s academic performance is due to the child’s inability to pay attention or be alert when in fact the problem may be with the child’s

environment? Furthermore excessive use of methylphenidate in school boys has raised concerns in the United States (Fuchs, 2006). Misuse of methylphenidate and dextromphetamine has accounted for 16 percent of college students using the drugs as study aids (Fuchs, 2006). As a result the use of these drugs has been very controversial.

Ethical concerns in brain enhancement through pharmaceuticals include safety (Fuchs, 2006). For example, methylphenidate can increase the short term capacity of one’s working memory at the expense of information adequately harnessed in meaningful, higher order knowledge (Fuchs, 2006). Furthermore unanticipated consequences and side effects from this drug are long term (Fuchs, 2006). What happens is that memory enhancement may impair memory retrieval in some individuals because the natural balance between remembering and forgetting could be interrupted by an overload of memories in the brain (Fuchs, 2006).

Competition between individuals is another ethical concern for pharmaceutical brain enhancement. For instance once pharmaceuticals are more widely spread then individuals may try using this method for a competitive edge towards better grades at school or for keeping a job (Fuchs, 2006). In addition those who may be of lower socioeconomic levels may not be able to afford the “ competitive edge” and are placed at an even greater disadvantage (Fuchs, 2006).

Another ethical consideration for pharmaceutical brain enhancement is that it changes the human condition by manipulating our subjective experiences, cognitive abilities, and personality traits (Fuchs, 2006). Mind enhancement

according Fuchs (2006) threatens to devalue human life and its imperfections, it fosters an illusion that one must be constantly happily and it villainies natural forgetfulness and negative moods. The use of pharmaceuticals for brain enhancement interferes with one’s own personal development and one’s ability to cope with their fears, failures and seatbacks. Perhaps prescribing brain enhancing drugs just place the responsibility of solving ones problem on a drug rather than finding a sense of responsibility to oneself to come up with solutions to ones’ life problems.

Brain/Computer interfaces (BCI’s) have multiple uses. Pacemaker like brain implants help individuals with Parkinson’s disease and those with tremors (McGee & Maguire, 2007). Treating depression has been shown effective in clinical trials with Vagus nerve stimulators constructed by Cyberonics (McGee & Maguire, 2007). Experimentally in cases of spinal cord severage, systems for functional neuromuscular stimulation are being used (McGee & Maguire, 2007). Patients with “ locked in” syndrome have received brain to computer interfaces enabling one to communicate via computer by thinking about moving the cursor (McGee & Maguire, 2007). Artificial vision systems enables the blind, using a cortical implant to navigate independently, to read letters, and through electronic interface it allows one to watch television, access a computer, and use the internet (McGee & Maguire, 2007). The device Braingate has been used on a severely paralyzed patients, through a brain chip, to enable individuals to access e-mail, play computer games, control a television, and turn lights on and off by thought alone(McGee & Maguire, 2007). Researchers have been able to restore hearing in deaf patients by inserting a penetrating device inside the brain stem (McGee &

Maguire, 2007). A clinical trial towards restoring speech is being used to restore speech from an implantable BCI (Alpert, 2008).

The future of BCI’s crosses from assisting the physically ill and handicapped to assisting government in their Department of Defense strategies. Neural prostheses will be used in future developments to enable users to move mechanical devices with thoughts and monitor not only the patients goals of what they want to reach for but also their motivation and mood(McGee & Maguire, 2007)(Alpert, 2008). The Defense Advanced Research Projects Agency (DARPA) has allotted $24 million to support research into the proposals for brain machine systems in six different laboratories (McGee & Maguire, 2007). These projects have the objective to control robots and airplanes through thought alone (McGee & Maguire, 2007). British Telecom’s Artificial Life Team is working creating a chip called Soul Catcher 2025 (presumably ready, 2025) which goes behind the eye and records the individuals thoughts, sensations, and experiences throughout their life (McGee & Maguire, 2007). In order to record all experiences multiple chips would need to be used (McGee & Maguire, 2007). The technology would allow users to transfer or transplant memories and experiences from one user to the next (McGee & Maguire, 2007).

Currently not all BCI’s are available to all groups of people. Brain interfaces such as the Braingate costs 50, 000 for the procedure and equipment used and follow up costs vary (Brown University, 2005). In the future, after FDA approval, and commercial marketing it is possible that private insurance and Medicaid may pay for BCI’s like the Braingate (Brown University, 2005).

Individuals who want the Braingate procedure pay out of pocket (Brown University, 2005).

Not being able to offer enhanced learning procedures such as BCI's to all individuals' raises the issue of fairness. Is it fair to only help the have's and not the have not's when both can benefit from a brain computer interface procedure due to their disease or handicap? If brain interfaces are not made available to individuals who meet the requirements for its uses (physical impairment, disease, etc.) then it could mean a loss of quality of life in individuals who come from low socio economic levels.

BCI's should be regulated for its potential uses for enhancement purposes in " healthy" individuals. BCI's used for the purpose of intelligence enhancing for people who have no disability, or BCI's used for controlling weapons or heavy machinery such as automobiles and airplanes like DARPA has proposed should be regulated. Perhaps international laws could be made to regulate the uses of BCI's so that this technology enhances only those who have a disability or disease and not individuals who just want to be enhanced for a job, acquiring a job, or performing better at school. When enhancements are made because a person thinks they need it rather than truly needing because of disease, illness, or physical impairment then inequality between those who have and have not will get larger.

Regulating who can control BCI's is an important consideration. Currently in the United States before a medical device can be marketed it must meet the requirements of the Food and Drug Administration (FDA) (McGee & Maguire, 2007). Although these devices are regulated to some degree the question as

to whether the investigation of the FDA is adequate (McGee & Maguire, 2007). For instance , required post market safety reviews on devices are rarely done and the focuses of FDA review is establishing the indications for use, methods of safe placement , individual risks, to surgery and anesthesia, and compilation of adverse events related to device removals (McGee & Maguire, 2007). Clinical trials are then implemented to assess the efficacy of the device and its safety (McGee & Maguire, 2007).

Regulations for BCI operators should also be mandated. For instance the capabilities of BCI's in the future could mean that individual's will not have control over their actions and that an operator can control the individual (McGee & Maguire, 2007). Individual's that control the operation of BCI's installed in patients have an enormous power in their hands. BCI's installed into patients could make these individual vulnerable to a doctor or governments control (McGee & Maguire, 2007). For this reason BCI's should be regulated internationally.

Learning enhancements through BCI's are quickly developing. BCI's can enhance the learning processes and experience of individuals who are disabled and increase their quality of life. Conversely this same technology can be used to enhance healthy people and give one a competitive advantage. Enhancing healthy people can lead to making them robot like, or allow one to control robots, weapons, and heavy machinery through thought alone (McGee & Maguire, 2007). Perhaps one of the most important concerns of using BCI'S in healthy people is what will happen to humanity and the human condition? What will happen to ones concept of self? Would individuals with BCI's be responsible for their actions or empathetic towards

others? Offering BCI’s to enhance healthy people seems to be a very slippery slope and should be avoided. Technologies such as BCI’s should be embraced to help individual with disabilities and illnesses have a better quality of life. However this technology should not be allowed to enhance healthy people. Consequences to the human condition could be affected negatively as well as society and environment. Proposing international regulation of such devices seems to be appropriate form of action to prevent such detriments in the future.

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