

Ethical Problems Concerning Human Augmentation Technology and Its Future Aspects

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ABSTRACT

Human augmentation technology, which aims to elevate different capacities of humans through certain ways, thrives as the development of science technology, meanwhile, the ethical problems coming along with the progress of the technology challenge conventions and values of human beings. In this article, the basic categories of human augmentation technology will be introduced firstly. By providing definitions in accordance with the current knowledge of the domain, the article illustrates the profound meaning of each technology. Secondly, based on investigation of international incidents, the moral impacts brought by human augmentation technology will be discussed in this article. Lastly, by integrating data and information from literature of various aspects, the future of human augmentation is mentioned in the article as well. Regardless of the fact that it takes much effort to better the regulations and supervision of human augmentation technology, the practical versatility of human augmentation deserves attention and devotions. Therefore, the author concluded that the positive influence of human augmentation outweighs the negative one by proposing solutions that mitigate the public misgivings towards the technology.

Keywords: *Human augmentation technology, ethical problems, virtual reality, gene modification*

1. INTRODUCTION

Human augmentation technology is a term that is arduous to be defined accurately (e.g. Garcia T. et al., 2008[1]) because it is such an intricately interdisciplinary realm that too many factors need to be taken into account when drafting definition. At present, the universally accepted description of human augmentation technology refers to methods with which human beings can obtain abilities exceeding the normal level or can compensate for abilities impairments. This technology is, at least on the surface, obviously beneficial to human beings for its outstanding possibility to enable people to achieve better physical or sensory experience.

Human augmentation technology can be generally divided into four main categories: The first one is medication augmentation, which means man use medications to enhance cognition, emotions, or body functions, including but not limited to Ritalin; The second one is genetic augmentation, which means genome modifying treatments on human embryos to obtain desired traits or reduce the possibility of genetic diseases, including but not limited to germline genome editing (GGE); The third one is mechanical and/or

electronic augmentation. This method is realized by implanting devices and wearable devices on human bodies to break through human physiological limitations, including but not limited to exoskeletons, VR lenses, AR lenses and smart watches; The last one is surgical augmentation. Man enhances the appearance and signs of human bodies through surgical operations. This method includes but is not limited to plastic surgeries.

Though advanced human augmentation technology is still premature for daily application besides laboratory trails, the lower-end technology begins to involve in our lives more and more often and wide-ranging. With the unimpeachable and promising aim to propel human beings to thrive better in a scientific way, human augmentation technology is about to impose changes on humans, externally or internally, which would highly probably arouse societal concerns about the consequent ethical problems.

Targeting to discuss the ethical issues brought by human augmentation technology and put forward possible solutions to the problems, this article would specifically analyze the stimulus of ethical controversy toward human augmentation technology in the following sections. By researching the existed cases and theories,

this article reviews the conclusion of previous studies and innovates novel points of view.

2. ETHICAL PROBLEMS CAUSED BY HUMAN AUGMENTATION TECHNOLOGY

2.1. Social inequality

Even though society admits that the ultimate goal of human enhancement is good, it still brings many problems in practical application. When the human augmentation technology widely prevails in certain areas but leaving the other areas without the help of the technology, it might pose prominent threats to the equality of human beings from different places.

First of all, social resources are limited and scarce to the needs of human development, so not everyone has the opportunity to enjoy the benefits of human augmentation technology. At this time, for those who have not been enhanced, the man-made difference might distinguish people with human augmentation technology from normal people when they are faced with the same competitions. Whether in sports competitions or in any other field, they are always in an unequal competitive environment and at a disadvantage compared with those who have been utilizing human augmentation technology. In essence, it to some extent destroys the system of fair competition, reduces the opportunities for those who are not enhanced to participate in fair competition, and brings great pressure to those who are not enhanced by human augmentation technology.

In reality, humans with enhanced workforce by wearing exoskeletons would be considerably more competitive than normal workers. Reports illustrate that in Europe, workers of the vehicle manufacturing industry are gradually equipped with exoskeletons, such as dual-arm exoskeletons and back-support exoskeletons. As an unexpected outcome, the equality of working conditions and payments arouses controversy. It is not yet clearly defined whether the exoskeletons users should have the same working hours as they used to have. Because the employees are working at a comparatively lower work intensity with the help of the exoskeletons, the employers would think that a longer working time should be imposed to offset the difference of labor output that the employees are paid for. Meanwhile, exoskeleton users hold the belief that they should have higher wages than non-exoskeleton users, for the reason that have relatively higher efficiency. However, non-exoskeleton users think contrarily since they reckon themselves to be more vulnerable to on-the-job injury without the aids from human augmentation technology [2].

What is worse, genetic enhancement is morally disputed yet theoretically feasible. The goals of genetic enhancement are to elevate certain targeted traits or

performance. Once some gene segments are modified in embryos, humans growing up from the modified embryos can obtain certain desired traits. Besides increasing resistance to diseases, genetic enhancement can be applied to augment human intelligence by expanding brain utilization and improve muscular strength by breaking physiological limits. Premature as the technology of intellectual enhancement is, with scientists' continuous working to tackle the ambiguity of genetic contribution to human intelligence, the great gap between intellectually enhanced humans and normal humans is far too obvious. The latest discoveries about gene's contribution to humans' intelligence level reveal the possibility of genetic enhancement of intelligence, simultaneously showing that the modification can increase human intelligence by at least 10% [3]. The subtle lifting would eventually lead to unequal competition in the academy or working environment.

2.2. Security

Aiming to augment the immunity of human beings or to eliminate a certain genetic disease, gene modification is considered to be an advantageous technique in human augmentation, for its potential to decrease the prevalence of genetic diseases on a population level.

Nowadays, the technology of CRISPR-Cas9 genome editing has proved to be an accurate, effectual and rapid modification of DNA. The unprecedented human embryo experiment with CRISPR-Cas9, which demonstrated successful directional removal of a segment in the β -globin gene [4], took place in 2015. Ethical disputes were aroused once the news was released. Regardless of the fact that the enhancement in gene segments might potentially eliminate the disease from the infant, if the embryo were used to establish a pregnancy, the security of performing such innovative operations on human embryos remains opaque.

Controversy on the topic of genetic modification surged to a peak when a Chinese biologist, Jiankui He, directly modified the gene segment CCR5 on human embryos, which were afterward used to establish a pregnancy and were given birth to, to enhance resistance in HIV in the children. In the circumstance, He diminished the possibility of infection to HIV by modifying an allele of the gene CCR5 to enhance resistance or slow down the progression of HIV infections. However, according to the Guiding Principles for Ethical Research from the American National Institute of Health, He's research violated most of the ethical norms severely. Not only did He's operation show little social and clinical value, for the reason that the technique used in the experiment had a mature development and thus it no longer required testing of this level, but also it lacked adequate informed consent and independent review. Critics point out that without being sufficiently evaluated by an independent agency about its risk-benefit ratio or

supervised by a third party, He's project is ethically and scientifically unacceptable, for it overlooked the risks of subsequent mutation and deprived the rights of the newborn children to objectively choose an intact or modified immune system. Whether the infant the right to choose enhancement will be an intractable problem for us to ponder. This modification is irreversible, which may partially increase the child's competitive advantages, but may also constrain the child's future choices and opportunities.

Criticism towards He largely represents the public ethical concerns about gene modification, one of the potentially positive human augmentation technologies. Besides the concerns mentioned, what adds to the public misgivings is that the recondite explanation of security assurance of gene modification in human embryos that would be used to establish pregnancies. Publications involving GGE lead experiments for various purposes, but all these papers and studies might provide an insight into the effectiveness of genome editing, simultaneously revealing its technical problems with safety implications for upcoming clinical GGE in human embryos, which therein include [5]: First is Mosaicism, a situation in which some cells of an embryo have different DNA from the others; Second is off-target effects, a situation in which unexpected changes in the genome segment outside of the targeted sequence occur; Third is on-target unwanted modifications introduced inside or next to the targeted locus.

All of the mentioned incidents would pose detrimental and capricious influences on an organism. With limited progress to solve the issues, for example, a study by Ma et al. (2017) [7] showing that injection of CRISPR-Cas9 system at the moment of fertilization reduces mosaicism, concerns about failure on human-embryo gene modification continue and the consequent ethical disasters impede the further promotion of the technology in the public.

2.3. Social control

As with many kinds of technology, human augmentation technology helps elevate human sensational feelings and even genetic performance. Nevertheless, it can be modified into an anti-social tool.

On one hand, gene modification technology, which shows a relatively promising future among all the human augmentation technologies, can be used as a weapon against certain sections of society. Terrible and irrelevant as it might sound, criticism has pointed out that because of the variation of genetic compositions among different races of people, devastating gene modification, aka gene weapons, targeting certain groups of population is scientifically possible. Gene weapons are based on the recombination of the deoxyribonucleic acid with the help of genetic engineering. The tremendous killing power

and the comparatively low cost make gene weapons more appealing to extremists. Specified genocide is now made possible with the advancement of genetic modification technology.

On the other hand, as the technology thrives, people would get more used to the existence of the devices that provide the service. Under this circumstance, human sensing augmentation technology devices that are used to provide an immersive information-receiving environment, for example, VR lenses, or even the more aggressive brain-computer interfaces, would probably become the propaganda tools of those who want to control the public opinions. With a far more comprehensive dimension of information telling, VR lenses are able to immerse a person in an artificial but impressive story-telling theater, where people would be highly susceptible to the incoming information regardless of its credibility. As the sensory experience of users can be determined and fabricated by the programmers or manufacturers, it would only be a conundrum for users to differentiate the authenticity of the story that they are told to.

2.4. Privacy

Modern people strive for efficiency in working and living by many means and human augmentation technology will be their preferred option, especially the increasingly popular wearable device, such as virtual reality lenses, augmented reality lenses, exoskeletons and smart watches. The advantages of wearable devices are so obvious that people find them to be perfectly suitable for their pursuit of efficiency. With cheaply available wearable devices, people get used to them quickly. Besides shopping at home through VR lenses, people can hold a virtual meeting at any place with augmented reality lenses, and smart watches can detect heartbeats and monitor life functions with advanced sensors. Nonetheless, as mentioned previously, human augmentation technology can be utilized in social manipulation. Also, for the same reasons, wearable devices can be used to obtain personal information illegally.

In order to provide users with a smooth and comprehensive experience, most wearable devices collect personal information to optimize the algorithm dedicated for an individual user. During the process of optimization, users' traces, including personal data and confidential information, are technically necessary recorded. With countless sensors and receivers on the devices that have already become part of modern lives, wearable devices are covertly obtaining and sending users' accurate locations, moving trails, and even communication records with other people to servers. With the developments of big data, artificial intelligence and 5G technology, all the collected personal information can be immediately analyzed by cloud servers and the results can be sold to companies for precise advertising and direct promotion.

3. FUTURE ASPECTS OF HUMAN AUGMENTATION TECHNOLOGY

3.1. Development trends of human augmentation technology

By extending human ability beyond inborn abilities, it would probably modify society into a better or worse situation under different circumstance.

In the foreseeable future, human augmentation would prevail in a way that aligns to our daily needs. Wearable devices would be the most popular among all because they are easily accessible in daily lives and are handy to get the hang of them. Through wearable devices, human can have a distinguished sensation on touch, gustatory and olfactory with the help of different sensors. Also, humans can enjoy a far better personal computing services when the ubiquitous computing, a technology provides anytime computation and access to networked information or devices, comes to reality and it's technology presented by wearable devices. Exoskeletons are playing a significant role among all the wearable devices for their broad usage in industry, military and daily lives. Not only can exoskeletons help the disabled restore mobility, but also they can reduce the effect of heavy payloads of certain careers and thus decrease the possibility of injury to protect human rights. Exoskeletons are expected to be in light-weight and low-power-consumption configurations so that they can work for a reasonable duration, and exoskeletons shall be applied to humans with other wearable devices to ensure an ideal experience. On the other hand, gene modification technology would also encounter giant leaps as people are devoting more than ever to research on bioengineering within the COVID-19 impact.

As people are crying out for more personal rights and freedom for using technology, human augmentation technology might develop in a comparatively free path with only market regulating and limited supervision in the short future. In theory, the government should take a neutral attitude towards people's behavior to improve their quality of life and happiness by adopting appropriate enhancement technologies, as long as these enhancement methods do not affect or harm other people [6]. People can freely choose a certain enhancement technology according to their own needs, as long as the chosen enhancement technology does not harm other people or social development. People should respect the autonomy of others, that is, self-determination, and tolerate the choices made by others. However, regulation by the market does not mean that the state has no responsibility and obligation for the development of human augmentation technology.

On the other hand, human augmentation would probably be harmful to some extent. Besides gene modification, internal human augmentation can also be

realized by taking medications that help achieve better recognition level. With limited regulations or review mechanisms on prescribed recognition enhancing medications, doctors and pharmacists are feeding a trend of abuse of psychotropic medications that elevate overall brain performance. Ritalin, Modafinil and Adderall are the most common medications that were used for enhancing brain performance. Data have shown that 30% of the interviewees in North American have ever taken one kind of the mentioned medications at least once in the year 2017, however, the percentage was only 19% in 2015. A higher ratio of the mentioned medications was observed in Europe, and also the number witnessed significant growth each year. Prediction can be made that in the future the usage of these medications would be of a wider range and involve more and more people, especially young students. Those who have ever used these brain-performance-enhancing medications would tend to rely on the medications because of their appealing effects. However, medical cognition enhancement can lead to biochemical reactions in the brain. For long-term users, there may be a risk of complications and the drug safety of children and adolescents is of particular concern.

3.2. Solutions to mitigate the existing ethical problems

Though the human augmentation technology is developing fast, the corresponding laws and regulations are still in sluggish progress and the situation leads to the lack of legal basis for the supervision of the technology's development. What we need to do now is to enhance technology development while comprehensively predicting its potential social, political, economic and ethical influences.

Most of the ethical issues raised in the field of human-technology interaction can probably be tackled by implementing the following measures:

Establishing a sound legal and supervision system: states and governments should cooperate together to draft legislation that regulates misuses of human augmentation technology and found an international enforcement agency. The government should provide people with sufficient knowledge and information related to enhancement, ensure people's right to know, and enable the public to fully evaluate the advantages and disadvantages of the enhanced technology. Secondly, the government should provide adequate rights protection for minors and people with intellectual disabilities to protect their legitimate rights and interests. Finally, the government should do a good job in monitoring the development of enhanced technology, and the state should supervise and evaluate the enhancement technology itself, so as to reduce the risk of technology [7].

Exerting independent moral review on innovative technology or experiments: The purpose of ethical norms is to minimize the possibility of exploiting individuals. It is not only a means to achieve goals, but also to retain the greatest respect for individuals. The ethical review refers to the review and supervision of biomedical research activities with human objects conducted by independent ethical review institutions according to certain ethical norms and ethical principles. The core purpose of ethical review is to restrain researchers and protect subjects. Restricting researchers is to make their medical research activities comply with ethical norms and legal provisions, and cannot endanger the health, life and dignity of the subjects. In other words, the medical technology of researchers can only solve the problem of what can it do, while ethics can solve the problem of what to do. Therefore, it is necessary to establish and improve an international ethical review and regulatory body to review, supervise and manage the research and development of human enhanced technology to ensure that the "enhanced bottom-line principle" is strictly observed.

For biomedical domain especially, self regulation shall be imposed and stakeholders should formulate corresponding human augmentation technology and enhancing drug / surgical technique research and development guidelines and risk assessment standards. Even with the absence of a formal legislation framework or a comprehensive review system, biomedical specialists have the capability and responsibility to monitor the usage and development trend of the upcoming human augmentation technology. Developed by specialist groups or state departments, self regulation guidelines or proposals might not have the force of law, but they have certain deterrence that violation of established professional standards can result in reprimand or more serious consequences.

Elevating equality by more even distribution: Unbalanced regional development impedes the promotion of new technology. In order to offer a roughly fair provision of technology to most of the population in the world, efforts, including forming charities to share new technology worldwide, strategically lowering the cost of technology utilization and promoting acceptance toward new technology, should be made. The COVID-19 vaccine, for example, as one of the medical human augmentation technologies, are being distributed unequally around the world. Developed countries hold most of the vaccines while some relatively less developed countries have few. The COVAX Project is founded and dedicated to promote equality of vaccine distribution. Similar allocation mechanisms shall be encouraged and ensured to function efficiently.

4. CONCLUSION

The ethical issues of human augmentation technology are not only related to individual freedom, but also needs to consider the impact on others and society as a whole. Whether the state or government should participate in it and adjust or restrict the development of human enhanced technology needs to be analyzed according to the specific types of problems. The mentioned negative impacts can not be taken as the only factors to deny the development and application of enhancement technology because human augmentation technology also has its many technological advancement and social benefits. Therefore, we should not take an extreme attitude towards the development of human augmentation technology, but we need to be more cautious and responsible to anticipate the consequences, so as to actively prepare for response.

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