LEGAL ASPECTS OF BRAIN-COMPUTER INTERFACES

by

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This paper provides a legal introduction to brain-computer interfaces, a technology that enables a direct communication pathway between organic nervous systems and information and communication technologies. Overview of the technology is provided together with a summary of its possibilities. Analysis of legal implications is provided with regard to the relevant fundamental human rights. Namely, the questions of the technology impact on human dignity, right to privacy, freedom of thought and freedom of expression are examined. The conclusion provides recommendations for future legislative reactions. Legislators should carefully examine the technology and set out a legal framework that would use brain-computer interfaces to broaden freedoms and rights of humans rather than limit it or use the technology for public purposes.

KEYWORDS

Brain-computer interface, human rights, right to privacy, freedom of thought, freedom of expression, human dignity, free will, identity.

1. INTRODUCTION

New technologies pervade our lives. Their impact on human beings has been constantly growing. However, a very interesting technology combining neurological research with engineering and information and communication technologies have appeared in the society: brain-computer interfaces. The technology seems to be "a dream-come-true" for sci-fi enthusiasts and a nightmare for human rights lawyers. In general, the technology enables

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people to exploit and direct neural activity of organic systems in order to achieve specific goals. Despite the fact that the original intention for development of the technology was for therapeutic purposes, brain-computer interfaces and their applications have been developing rapidly, affecting more and more spheres of human life.

The aim of this paper is to briefly present the technology of brain-computer interfaces, summarize its potential with help of illustrative examples and to frame their potential into a legal perspective. Namely, an impact of the technology on the current notion of fundamental human rights shall be explored. Finally, the paper should conclude with recommendations on how the law should deal with brain-computer interfaces.

2. BRAIN-COMPUTER INTERFACES

Brain-computer interface (hereinafter BCI) is a technology that was pioneered in 1964 by Dr. Grey Walter who was the first person to connect electrodes to a brain of a patient undergoing surgery. He asked the patient to press a button in order to perform some task with a slide projector while he was monitoring patient's brainwaves. Dr. Walter found out that the projector reacted quicker and based on the monitored brain activity responded even before the patient himself pressed a button. This way a control of an external device without movement was achieved for the first time.[1] In general, the aim of BCIs is to "analyze brain signals in real-time to control external devices, communicate with others, facilitate rehabilitation or restore functions."[2] By analyzing brain signals the technology can bypass the natural nervous and muscular pathways that are normally used for communication or for performing some functions. Originally the technology was intended to help people with so called "locked-in" syndrome, i.e. paraplegic patients unable to move any part of their body, not even capable of an eye movement but still active in their minds. When using BCI systems "users explicitly manipulate their brain activity instead of using motor movements to produce signals that can be used to control computers or communication devices."[3]

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1 Graimann, B., Allison, B. & Pfurtscheller G. (Eds.) 2010, Brain–Computer Interfaces: Revolutionizing Human–Computer Interaction, Springer, Berlin.

2 Guger, C., Allison, B. Z. & Edlinger G. (Eds.) 2013, Brain–Computer Interface Research: A State-of-the-Art Summary, Springer, Heidelberg.

3 Tan, D. S. & Nijholt, A. (Eds.) 2010, Brain-Computer Interfaces: Applying our Minds to Human-Computer Interaction, Springer, London.

The BCI enabling output communication from a person to a device functions as follows: brainwaves of a person[4] are monitored with help of either an invasive device (an implanted chip) or with help of a non-invasive device (for instance a wearable headset equipped with electrodes) and transferred into a device that processes recorded brainwaves with help of specific algorithms. These brainwaves are translated into respective orders that are then performed by a connected device. This device can be a prosthetic limb or a computer system enabling a person to write on screen just by focusing on letters or words they want to write.

However, this is not the only use of BCIs. Up to now the technology has developed significantly. Since the technology can be defined as a direct interface connecting nervous systems with information and communication devices, it is necessary to broaden the definition of BCIs and include technologies that enable both way communication between a nervous system and an ICT device. This technology includes a possibility to influence brain by stimulating its specific areas with help of electric signals. The first aim of this development was again therapeutic. It has been proved that for instance deep brain simulation "can alleviate the effects of disorders such as depression or Parkinson's disease."[5] This technology shall also enable construction of robotic limbs that would provide its users not only ability to move the limbs very intuitively but also to receive feedback and sense for instance pressure or heat.[6]

Since the two-way communication was opened, new ideas have arisen and applications have been proposed. One of these applications can truly be called cutting-edge because it enables interconnection of two nervous systems and, recently, also of two brains. These two are not the same since interconnection between two neural systems introduced for the first time by prof. Kevin Warwick and his wife Irena Warwick only enabled a limited common experience by a specific reaction in peripheral nerves of interconnected people. However, in 2009 the first computer-mediated telepathy was performed at the University of Southampton when it was possible to prove that thoughts on a sequence of binary numbers was transferred to the brain

[4] In fact an extensive research has been performed on animals, namely monkeys, rats, fruit flies, etc. However, in this article the focus is put on a human.

[5] A pacemaker for your brain [WWW Document], n.d. Phys.org. URL http://phys.org/news-196958657.html (accessed 2.14.14).

[6] Cobb, K., n.d. Optical interface to link robotic limbs, human brain [WWW Document]. Phys.org. URL http://phys.org/news203244594.html (accessed 2.14.14).

of another person and could be read by a device monitoring the recipient of the transferred thoughts. Unfortunately, the technology is not yet so advanced that the recipient could be aware of the information received. Only a specialized technology can read it from the recipient's mind.[7]

The probably most exciting experiment, however, was a case of the first inter-racial interconnection of nervous systems between a human and a Sprague-Dawley rat. In this experiment a human subject was enabled to control a movement of a rat's tail simply by manipulation of own thoughts while the brain of the rat was stimulated by respective electrical signals. The rat had no more control over this part of her body.[8]

To summarize, BCIs not only provide a possibility to control external devices by a mere thought, but also enable a direct stimulation of brain in order to mediate new perceptions in mind as well as they enable interconnection of minds and transfer of information through brain-to-brain communication. Some research papers even suggest that this technology will lead to technologically enabled human enhancement when people will be able to perceive previously unperceivable ranges of color or sound spectrum. Moreover, memory or intelligence enhancements are presumed by some as well.

BCIs are currently used in more spheres. Apart from medical use of BCIs, the technology is currently being exploited by a military industry, gaming and entertainment industry and by companies that aim to provide their customers services to improve their productivity by teaching them to concentrate better with help of biofeedback or by providing them solutions to quickly control IT devices.

3. INTERACTION BETWEEN BCIS AND LAW

New technologies confront legal systems with difficult questions often interfering with a traditional notion of ways how things are done and regulated. Social values and morality are challenged and new approaches must be found in order to preserve stability in the society. So far, law represents the most effective way of regulating this social dynamics influenced by - among others - generally accepted values, rebellious opinions of various so-

[7] Communicating person to person through the power of thought alone (w/ Video) [WWW Document], n.d. Phys.org. URL http://phys.org/news174044805.html (accessed 2.14.14).

[8] Yoo, S.-S., Kim, H., Filandrianos, E., Taghados, S.J. & Park, S. 2013. 'Non-Invasive Brain-to-Brain Interface (BBI): Establishing Functional Links between Two Brains', PLoS ONE 8(4), e60410.

cial groups, new incentives from different cultural backgrounds or uncertainty caused by a lack of knowledge.

What concerns the relationship between law and new technologies, law can be considered as "a method of technological risk management and plays a constantly increasing role in that regard."[9] The following subchapters should summarize an interaction between challenges posed by BCIs and particular fundamental rights. With regard to the identified interaction a proposal shall be made in the conclusion in order to manage the risks posed by the technology.

3.1 HUMAN DIGNITY

Although some claim that human dignity is "no more than respect for persons or their autonomy"[10] and that "[d]ignity is a useless concept in medical ethics and can be eliminated without any loss of content"[11], this important legal concept cannot be dismissed easily. The notion of human dignity represents a basic legal concept, a principle from which the principle of equality of human beings as well as the fundamental human rights are derived.[12] The Universal Declaration of Human Rights states in its Article 1: "All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood."

In this sense human dignity and the principle of equality shall function also as a safeguard in case positive law would try to circumvent this principle considered also as a basis for justice.[13]

There are several notions of what dignity means. The first notion relates the concept of dignity to the concept of human worth, a particular significance of a human being that humans recognize themselves.[14] However, dignity can be understood also as "a property of relationships between humans – between, so to speak, the dignifier and the dignified. [… It] designates a

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[9] Pöysti, T. 2004, 'ICT and Legal Principles: Sources and Paradigm of Information Law', Scandinavian studies in law, vol. 47, pp. 559-600.

[10] Macklin, R. 2003, 'Dignity is a useless concept', BMJ: British Medical Journal, vol. 327, no. 7429, pp. 1419-1420.

[11] Supra note.

[12] Malpas, J. & Lickiss, N. (Eds.) 2007, Perspectives on Human Dignity: A Conversation, Springer, Dordrecht.

[13] Kateb, G. 2011, Human Dignity, Harvard University Press, Cambridge.

[14] Supra note 13.

way of being human, not a *property* of being human."[15] In this sense a right to autonomous behavior needs to be noted. According to Malpas "what counts as a diminution in human autonomy—a diminution in the capacity of human beings rationally to make their own decisions and to determine their own lives—is ipso facto a diminution in human dignity and in human being."[16]

Moreover, the concept of protecting human dignity has a strong psychological reasoning as respect of one to another and avoiding instrumentalization of humans or their specific groups prevent violence in the society.

In this regard BCIs have a potential either to broaden the autonomy of a person by enabling her to have wider possibility to make decisions (for instance BCI enabling a person to move better or to communicate more effectively with the environment gives her new options to achieve her goals) as well as a potential to completely suppress person's autonomy. As it was illustrated above a neural system can be stimulated by various methods in such an effective manner that a person loses control over for instance motoric movement of own muscles.

By specific use of the technology a person could be turned into a distantly controlled biological device that would serve others to achieve their purposes. Such use, however, drastically contradicts any notion of human dignity be it the notion highlighting a value of a person or the notion focusing on equal and respectful relationships among humans.

3.2 RIGHT TO PRIVACY

Right to privacy is an internationally accepted fundamental human right. According to Article 12 of the Universal Declaration of Human Rights "[n]o one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks." The first definition of the right to privacy was made by Samuel D. Warren and Louis D. Brandeis already in 1890. They defined the right to privacy simply as "the right to be alone".[17] There are, however, other concepts of privacy, such as Posner's definition of privacy as a right of an indi-

[15] Luban D. 2007, Legal Ethics and Human Dignity, Cambridge University Press, Cambridge.

[16] Supra note 13.

[17] Warren, S. D. & Brandeis L. D. 1980, 'The Right to Privacy', Harvard Law Review, vol. IV., no. 5, pp. 193-220.

vidual "to conceal discreditable facts about himself"[18] or Westin's notion of privacy as a control over own personal information.

Privacy plays an important role in a healthy mental functioning of an individual. Confronted with the possibilities of BCIs the idea of keeping one's own private space seems to dissolve. Not only that people currently face various surveillance technologies eliminating private space in their surroundings but the last barrier represented by impenetrability of the mind may soon be torn down.

Unfortunately, in order to function, the BCIs necessarily have to monitor neural activity of their users and, therefore, collect and process intrinsically private and sensitive information relating to their users. The technology even aims to reach the ability to truly read mind and identify contents of thoughts of monitored people. Obviously, such mental intrusion interferes with the most intimate privacy of a person.

The law would need to find a way how to safeguard this right since guaranteeing such right has even biological justification in order for people to function normally and without fear from being exposed, and, therefore, highly vulnerable.

3.3 FREEDOM OF THOUGHT

The right to freedom of thought is set out also in the Universal Declaration of Human Rights, namely in Article 18: "Everyone has the right to freedom of thought, conscience and religion; this right includes freedom to change his religion or belief, and freedom, either alone or in community with others and in public or private, to manifest his religion or belief in teaching, practice, worship and observance."

In the context of BCIs the right to freedom of thought and right to privacy are interconnected. In the past thoughts were considered to be private by its nature and not accessible to anyone else. However, technological means have changed the situation.

Given the human way of psychological functioning the BCIs seriously threaten the freedom of thought. Theoretically, given the possible threat of being monitored in their mind, people would be forced to change their "inner life". When being afraid of others, individuals could limit a scope of their thoughts which would, consequently, have a serious impact on their

[18] Solove, D. J. 2008, Understanding Privacy, Harvard University Press, London.

cognitive capabilities, intelligence and fantasies. An emotional life of a person and her identity as a whole could be seriously impacted.

3.4 FREEDOM OF EXPRESSION

Article 19 of the Universal Declaration of Human Rights states the following: "Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers."

When considering the relationship between the freedom of expression and BCIs, one important aspect must be noted. Ideas and thoughts have been considered immaterial and therefore not being an expression. Recorded brainwaves representing inner thoughts, on the other hand, might be considered as an expression since they have a certain physically imprinted form. However, in this respect a serious problem arises. In order to ensure functionality of a BCI a person is usually requested to think in a certain manner. Therefore, a specific expression is requested from her and this might limit the scope of the guaranteed freedom. Especially in case the BCI technology would be widely used for instance for authentication or daily communication, the social pressure would force individuals to use their minds in a specific manner and collision with other guaranteed fundamental rights might occur.

It must be noted though that there have already been cases when the whole society adopted new ways of communication without considering it as limiting to their nature or their freedom and rights. Such case might be possibly solved with help of analogy to previous cases.

4. CONCLUSION

Obviously, brain-computer interfaces possess a huge potential. Especially the possibility to use BCIs for direct and efficient control of a brain and a nervous system of an individual are rather threatening. A person could easily become a puppet in hands of another person with access to control a console of an implanted stimulating device or a wearable device that can simulate various areas in brain with ultra sound.

Moreover, the technology can have a serious impact on the very individuality of a human being by affecting their way of thinking and by possibly increasing their vulnerability.

Having a clearly positive potential when used properly and for legitimate reasons, the development of the BCIs should be promoted as much as possible. However, so called risk management measures must be put in effect to prevent technology misuse. Legislators should carefully examine the technology and set out a legal framework that would use brain-computer interfaces in such a manner that this will lead to broadening freedoms and rights of humans rather than limiting them. Moreover, use of the technology for public purposes should be completely avoided. Given the equality of all members of the society, their integrity and privacy of their mind should be forever preserved to prevent possible misuse that is so common when acting "for the higher good of the society".

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