Proceedings of the 2nd International Conference on Biological Engineering and Medical Science (ICBioMed 2022), Part II
DOI: 10.54254/2753-8818/4/20220689

A Review on the Ethical Issues in Neurotechnology

Yang Wu

High School Affiliated to Renmin University of China, Beijing, 100097, China

Yang_Wu2023fall@163.com

Abstract: Neurotechnology is rapidly evolving and there have been great advances in medical treatment, including some neurology and psychiatry disorders. Many people have been given new lifesaving treatments which help relieve their suffering. As the capabilities and applications of neurological devices have evolved, attention has been drawn to potential ethical challenges related to agency, identity, privacy, equality, regulation, and justice. This paper reviews and summarizes the current exploration of the ethical issues in neurotechnology, especially from the aspects of privacy and identity. It assesses the key methodological and ethical challenges associated with neurotechnology for today. In particular, it suggests what safeguards should be implemented in the field to reduce the concern about ethical issues.

Keywords: ethical issues, neurotechnology, privacy, identity.

1. Introduction

Neuroscience and neurotechnology are expanding quickly as a result of recent improvements in electrode technology, imaging methods, and computational capacity. It is now possible to record from massive assemblies of neurons and decode their activity to extract information thanks to recent advancements in neuroscience and technology [1]. Wearable neurotechnology has seen a rise in development in recent years due to the availability of powerful sensors and ever-smaller computer processing components [2]. Medical personnel are able to detect and treat illnesses as well as aid in the healing of injuries more and more efficiently thanks to the application of this equipment. A growing number of medical and mental illnesses, including stroke, spinal cord injury, essential tremor, Parkinson's disease, Obsessive Compulsive Disorder (OCD), and depression, are being treated with devices that are either in use or under development [3]. Neurotechnology devices raise unique challenges for regulation [4]. Efforts to develop ethical approaches to neurotechnology have endeavored to involve different stakeholders, including doctors, funders, and users. Current research available basically investigates the attitudes of these different stakeholders towards neurotechnology by means of a survey. A formal assessment of the social and ethical implications of specific neurotechnology has been done. The purpose of this paper is to summarize and evaluate a few common ethical issues in privacy and identity and to analyze them in the context of cases that have occurred. This paper can give enlightenment on the possible solutions to the ethical issues in the development of neurotechnology.

2. Privacy issues and possible solutions

In 2019, Facebook provided the data firm Cambridge Analytica with unrestricted and unauthorized access to the personally identifiable information of more than 87 million Facebook users [5]. This

© 2025 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/4/20220689

incident has stimulated discussion about the social impact of technology and the risks to citizens' privacy. In the past, security threats have historically been prevalent throughout the early stages of technology innovation due to a lack of strict security measures built into the technologies and insufficient legislative frameworks. Neural technologies also face such privacy challenges. When self-monitoring is done at home with Brain Computer Interface (BCI), portable electroencephalogram-graph (EEG) headsets (Fig. 1), for example, can detect changes in the user's brain waves as they think, thereby extracting their identity information without their knowledge [6]. “Flappy Whale” is a BCI game that University of Washington researchers have created. The experiment's findings demonstrate that subliminal stimulation can be used to obtain private and delicate information from BCI users [7]. Neuroimaging, such as functional magnetic resonance (fMRI) also raises worries about invasions of mental privacy. In a University of California study, participants saw movie trailers while having an fMRI scan. The researchers utilized a machine learning technique to rebuild the films after decoding fMRI data [8]. Overall, there are three reasons why neurotechnology is a challenge in terms of privacy. First, neurotechnology collects a large amount of data in the process of being used. For instance, personal information about the user can be collected when applying brain wave maps. Second, this data can be collected without the user's knowledge, i.e., subconsciously. Third, the special feature of this data is that it includes a wealth of personally identifiable information, such as health status, preference, etc. A proactive effort is required to improve the privacy and security of brain-related data outside of the framework of medicine and research in response to this emergent reality. Individual users, manufacturers or service providers of neurotechnology, and policy and regulatory agencies all require safeguards [9].

For the users themselves, there is a need to carefully read the informed consent form with detailed contents. Nowadays, many people make transactions without taking the terms of service seriously at all, leading to subsequent disputes. For neurotechnology, the information that the device can access is rich, versatile, and subliminal, so the type of information collected must be thoroughly understood by users. For service providers, there is a need to include in their terms of service: how and where brain data are stored, what information security measures are implemented, and who is legally liable under those circumstances [10]. For policy and regulatory agencies, rules need to be constantly updated in response to technological developments. Since neurotechnology is still a relatively new field, many problems occur because there are no clear laws to regulate it.

To conclude, neurotechnology is advancing rapidly and is now being used to treat many diseases, including Parkinson's and depression. In addition to the therapeutic benefits of neurotechnology, there are many issues to consider. Neurotechnology's threat to privacy stems from the wealth of information that can be gathered through brain-computer interfaces and fMRI. This is because by recording the brainwave activity of users, it is possible to infer how important the information is to them.



Figure 1. “Mind-reading” EEG headset by Loren Grush [11].

DOI: 10.54254/2753-8818/4/20220689

3. Identity issues and possible solutions

There is growing evidence that a large number of patients experience postoperative neuropsychiatric changes. The survey conducted by Gilbert [12] interviewed 17 patients with Parkinson's disease who underwent Deep Brain Stimulation in depth to study patients' first-person experiences in order to explore their self-perceptions after surgery. It was shown in the study that patients may experience self-alienation, which refers to a person feeling alienated from others and society at large [13]. However, based on the interviews, it can be concluded that this feeling of patients did not improve as a result of having undergone Deep Brain Stimulation (DBS) (Fig. 2). The study also mentioned that DBS may have a good effect on the patient's body, helping them to regain some strength to perform daily movements. However, it can also bring about an uncontrollable emotional outburst that is against the patient's will. Third, studies exploring whether the implant changes the patient's relationship with the body have concluded that most of the time, the patient is unaware of the device inside him or her. However, patients who use rechargeable devices do feel the presence of the devices [14]. Another study [15] was conducted on the changes in perceptions of self and interpersonal relationships in patients with obsessive compulsive disorder (OCD) and Major Depressive Disorder (MDD) after treatment with DBS. The study showed that patients' evaluations were polarized in terms of perceptions of self. Some believed that DBS was beneficial in improving self-perceptions because their emotional and physical condition improved after treatment, and they could be more energetic to face life and become more positive about themselves. And while suffering from MDD and OCD, it is in itself a kind of repression and masking of their personal character. But more patients have a worried attitude about self-perception [16]. Because the behavior after receiving DBS is not necessarily controllable. and either the individual patient's will or the device is responsible for this. The second is that in order to maintain patients' emotional stability, the device may control their brain activity and thus their emotions, which deprives patients of the right to experience life independently. The change in the patient's interpersonal relationships is that the family will be more likely to pass the buck to the device rather than the patient.

In conclusion, the threat of neurotechnology in terms of identity stems from the degree to which patients using DBS are subject to changes in treatment. This is because DBS first enables patients to do things that they could not do when they were ill, which is the effect of the treatment. But at the same time, because of the immaturity of the technology and the complexity of the brain, the emotional and cognitive changes that DBS produces are also present. These changes may lead patients to question their personal identity and who is responsible for the consequences of these behaviors when some of the behaviors and emotions are involuntary.

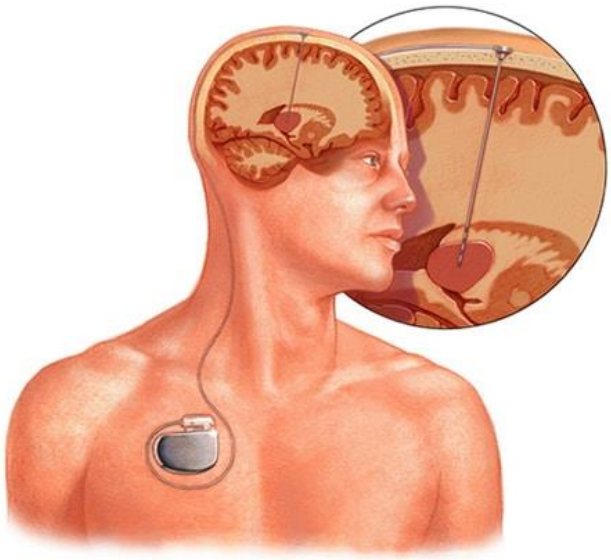

Figure 2. Deep Brain Stimulation [17].

DOI: 10.54254/2753-8818/4/20220689

4. Conclusion

Overall, the development of neurotechnology is certainly providing new ideas for treatment. But also because of the importance of the brain to the human body, many issues have arisen that need to be addressed, including ethical issues in privacy and identity. As discussed in this paper, neurotechnology collects a large amount of data about the user's personal information when being used. It can be collected without the user's knowledge, thus causing privacy issues. In addition, there is growing evidence proving that many patients experience postoperative neuropsychiatric changes, that is, patients may experience self-alienation by feeling alienated from others and society, thereby causing identity issues. So when problems are identified, they must be explored and resolved in a timely manner.

In terms of limitations of this paper, in the introduction of the issue of privacy, because the cases mentioned are conducted in an experimental setting, the results may appear different in practical applications. The proposed solution is also relatively general and does not solve the privacy problem of neurotechnology that effectively. Secondly, both cases in the introduction of identity take the form of a survey. The use of first-person science to describe one's feelings or experiences with the implant does not provide very objective evidence. Detachment is not necessarily self-perceived. As other studies have shown, relatives are usually more sensitive to self-change than the patients themselves [18]. And because of the complexity of identity and the unpredictability of the brain, the solution for this point is not mentioned in the paper.

References

[1] Roelfsema, P. R., Denys, D., Klink, P. C. (2018) Mind Reading and Writing: The Future of Neurotechnology. Trends in Cognitive Sciences, 22(7), 598–610. doi:10.1016/j.tics.2018.04.001

[2] Piwek, L., Ellis D. A., Andrews S., Joinson A. (2016) The rise of consumer health wearables: Promise and barriers.PLoS Medicine, 13(2):e1001953. doi:10.1371/journal.pmed.1001953.

[3] Christen, M., Muller S. (2017) The ethics of expanding applications of deep brain stimulation. New York: The Routledge Handbook of Neuroethics.

[4] Wexler, A. (2016) A pragmatic analysis of the regulation of consumer transcranial direct current stimulation (TDCS) devices in the United States. Journal of Law and the Biosciences, 2(3):669–96. doi:10.1093/jlb/lsv039.

[5] Isaak, J., Hanna, M. J. (2018) "User Data Privacy: Facebook, Cambridge Analytica, and Privacy Protection," in Computer, 51(8), 56-59. doi: 10.1109/MC.2018.3191268.

[6] Ienca, M., Haselager, P., Emanuel, E. J. (2018) Brain leaks and consumer neurotechnology. Nature Biotechnology, 36(9), 805–810. doi:10.1038/nbt.4240.

[7] Bonaci, T. (2017) in USENIX Enigma (Oakland, CA; 2017). https://www.usenix.org/conference/enigma2017.

[8] Nishimoto, S. et al. (2011) Curr. Biol. 21, 1641–1646.

[9] Ienca, M., Ignatiadis, K. (2020) Artificial Intelligence in Clinical Neuroscience: Methodological and Ethical Challenges. AJOB Neuroscience, 11(2), 77-87. doi:10.1080/21507740.2020.174.

[10] Ienca, M., Haselager, P., & Emanuel, E. J. (2018). Brain leaks and consumer neurotechnology. Nature Biotechnology, 36(9), 805–810. doi:10.1038/nbt.4240

[11] Grush, L. Those 'mind-reading' EEG headsets definitely can't read your thoughts: What EEG can and can't do (2016). https://www.theverge.com/2016/1/12/10754436/commercial-eeg-headsets-video-games-mind-control-technology.

[12] Gilbert, F., Goddard, E., Viaña, J. N. M., Carter, A., Horne, M. (2017) I Miss Being Me: Phenomenological Effects of Deep Brain Stimulation, AJOB Neuroscience, 8:2, 96-109, DOI: 10.1080/21507740.2017.1320319.

[13] Volkmann, J., Daniels, C., Witt, K. (2010) Neuropsychiatric effects of subthalamic neurostimulation in Parkinson disease. Nature Reviews Neurology, 6(9):487–98.

[14] Haan, S. D., Rietveld E., Stokhof, M., Denys, D. (2015). Effects of deep brain stimulation on the lived experience of obsessive-compulsive disorder patients: In-depth interviews with 18 patients. PLoS ONE 10 (8):e0135524. doi:10.1371/journal.pone.01355.

DOI: 10.54254/2753-8818/4/20220689

[15] Klein, E., Goering, S., Gagne, J., Shea, C. V., Franklin, R., Zorowitz, S., … Widge, A. S. (2016) Brain-computer interface-based control of closed-loop brain stimulation: attitudes and ethical considerations. Brain-Computer Interfaces, 3(3), 140-148. doi:10.1080/2326263x.2016.1207.

[16] Mendelsohn D, Lipsman N, Bernstein M. Neurosurgeons' perspectives on psychosurgery and neuroenhancement: a qualitative study at one center: clinical article. J Neurosurg. 2010;113:1212–1218.

[17] Mayo Clinic. Deep brain stimulation. https://www.mayoclinic.org/tests-procedures/deep-brain-stimulation/about/pac-20384562.

[18] Pham, U., Solbakk, A. K., Skogseid, I. M., et al. (2015). Personality changes after deep brain stimulation in Parkinson's disease. Parkinsons Disease 2015: article 490507. doi:10.1155/2015/490507.