Exorganic Posthumanism and Brain-Computer Interface Technologies

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Abstract: Transhumanism is a philosophical movement that argues in favor of technologically mediated transformation of humans. Some transhumanists claim that radical human enhancement could one day create new posthuman species. Two prominent paths could lead toward posthumans. Organic posthumanism maintains the essential role of the biological in posthumans. Exorganic posthumanism reasons for synthetic, electronic and digital qualities of future posthuman beings. This article is dedicated to the examination of the exorganic road to posthumans. Brain-computer interface technologies enable direct interaction between the mind and the virtual, therefore it is typically claimed that this technology could generate exorganic posthuman adaptations. It is argued, that current brain-computer interface technologies are under similar conceptual and ethical ambiguity, as some technologies for organic posthumanism. Brain-computer technologies are consequently tools, which are neutral regarding the posthumanism goal.

Keywords: *Transhumanism; posthumanism; human enhancement; brain-computer interface; bioethics.*

How to cite: Odorčák, J. (2019). Exorganic Posthumanism and Brain-Computer Interface Technologies. *Postmodern Openings*, 10(4), 193-208. doi:10.18662/po/103

1. Organic and exorganic posthumanism

The future is bright, or the future is lost. The last two decades have been the age of gradual philosophical reflection about the promises of new technologies (More & More, 2013). The narrative has changed, transhumanism has emerged. Sophisticated technological transformations of humans could lead to human enhancement. Complex technological transformations of humans could bring about posthumans. The transhumanistic path to posthumanism is covered by many extraordinary approximations of the future for us and the so-called other. Yet, it isn't clear what posthumanism is and what posthumans will be (Umbrello & Lombard, 2018). It is, however, clear that every complex transformation has its simple beginnings. The ones and zeros of the digital revolution are the unassuming premises that established the possibility for transhumanism. Information technology is therefore constantly the main candidate for new personal and social consequences, which could establish transhumanistic high hopes. Information technology is certainly alive and well, but the transformational technology landscape is changing. Breakthroughs in biological sciences and biomedical research point to a new, but a strange friend. Assumptions about human genome enhancement aren't just theoretical speculations. Lulu and Nana are the first humans that have been germline genetically edited (Begley & Joseph, 2018). The reasons for this procedure may have been therapeutic, but the results could be an enhancement. Lulu and Nana may have an inadvertent modification of the gene CCR5 that is linked with improved memory and health recovery (Regalado, 2019). The efficiency, cost, and availability of CRISPR tools, therefore, points to applications that are currently unimaginable.

Unimaginability is the craft of posthumanism. From a posthumanism point of view, one of the involvedly imaginable possibilities is the series of biotechnological procedures that could lead to genetically modified beings, which would be so biologically different from current humans, that they could be conceptualized as posthumans. I will call this possibility as organic posthumanism. Organic posthumanism is centered on the quest for biological modifications of humans and other organisms, which could bring about the creation of a new biological species. The main technological candidates for establishing organic posthumanism are for example gene modification (transgenic gene manipulation), gene editing (intragenic gene manipulation), assisted reproduction and embryo selection. In the organic posthumanism, technology is used just as a tool for the sake of biology. Biology maintains the necessary grounding for the functions of

organisms. Organic posthumanists thus typically don't believe that for example, rationality is possible without evolutionary biological groundings and conditions. On its own rationality without biology is empty. The technological enhancement of biology is therefore motivated by the supposed essential biological character of life and his (in the broad analytical sense) meaning. For short, organic posthumanism is biocentric. This biocentrism, however, has his conceptual and ethical price. If the center is bios than the intervention has to be at the heart and nature of the bios. This is precisely the reason why the first germline genetic modification of humans has caused worldwide scandal. Many opponents have argued that the procedure has crossed several ethical lines (Coller, 2019: 290). The public outcry is mainly concerned with the blurred distinction between therapy, enhancement and typical arguments about unnaturalness. Biomedical modifications are therefore strictly regulated and by some also vehemently feared. It may change, but for the time organic posthumanism seems to be inconvenient and farfetched for the proponents of posthumanism.

The second path to posthumans is oriented on the promises of information technologies. Maybe life is just another form of information. Biological qualities are seen as differently organized functions of organisms. Functions can be denoted, information can be represented, and thus life and organisms can be reconstructed and created by information technologies. I will call this approach as exorganic posthumanism. Exorganic posthumanism believes that new posthuman species will be created out (ex) of the ordinary biological constrains of current species through information technologies. Exorganic posthumanist also typically believe that posthumans will be not defined by biology, but solely by their new virtual, digital, informational and physical functions. The popularity of this kind of posthumanism is well known and relatively strongly embodied in the transhumanistic narratives about future posthuman scenarios (Sandu & Vlad, 2018). The reason for this popularity mostly lies in the supposed freedom of information technologies. After all information technologies are not (or should not be) regulated. It is believed that experimentation with information technologies isn't (or shouldn't) be restricted. And if it isn't regulated and restricted, than exorganic posthumanism seems to be the most effective and ethically permissible way for posthumanism.

One of the main technological candidates for the goals of exorganic posthumanism is brain-computer interface technology (BCI). For example, some valued higher biological functions of humans could be by BCI directly transformed and mediated to nonbiological environments. BCI could one day bridge and transcend the old gap between ideas and matter, subject and

object, body and mind (Schussler, 2017: 43), thus creating a new unique exorganic posthuman species. Many exorganic posthumanists, therefore, point to promising results of BCI research (Warwick, 2017: 70). BCIs, however, aren't just some forms of new hardware. BCIs are devices, which are (and will be) intimately integrated to organisms, and therefore are tightly and consistently socially controlled. Current BCI are under similar conceptual and ethical ambiguity, as many other biomedical technologies. For this reason, the BCI road to exorganic posthumanism isn't as free and unproblematic, as it is sometimes believed. In what follows I will therefore firstly describe the conceptual clarification of BCI (section 2.). The second part of the article deals with problems of therapeutic and nontherapeutic use of BCI (section 3.). The last section is dedicated to the analysis of current ethical problems of BCI (section 4.).

2. Brain-computer interface technologies

BCIs are technologies that in real-time facilitate direct communication between some external electronic devices and biological organisms. The communication facilitation is usually mediated by measurements of activation, or deactivation of spikes in neuronal activity of the brain of some specific organism. In this sense, BCIs are clusters of many different technologies, which can observe and transform brain activity by following the preferred goal. The goals can range from simple tasks, such as moving a cursor on a display just by learned pattern of concentrated and monitored thought, through advanced operational use for substituting some individual's physical and cognitive modalities by automated functional externalization, to complex direct collaborations and interactions between different brain activity patterns, devices and organisms (Pais-Vieira, Lebedev, Kunicki, Wang, & Nicolelis, 2013).

These different and technologically challenging levels of tasks are, however available because of the more or less simple activity potential correlation between the specific BCI and neuronal activity (or more neuronal activities, as in the case of advanced BCIs). If the specific neuronal activity can be measured, classified, evaluated, and if the neuronal activity can be changed, altered, or in some technologically feasible way modulated, then the BCI technology can be effectively used for many purposes. It is therefore not surprising that BCIs are nowadays successfully used for treating numerous diverse diseases, disorders, and injuries that have an underlying neuronal cause or ground. The last two decades have been the time of explosion of many different therapeutic and clinical BCI uses and

BCI procedures (Shih, Krusienski, & Wolpaw, 2012). In some cases, BCIs are even the only option for restoration of normal cognitive, motor or other biological and psychical functions.

The careful, but nowadays well established practical therapeutic use of BCIs, points to new directions of BCI applications. In principle, BCI could be used for direct cognitive assistance (neurocognitive guidance) and direct physiological assistance (object guidance) for persons with nonstandard neuronal activity (nontherapeutic use). BCI could also lead to some cognitive and physiological over the limit improvements that could be, by some definitions (Bostrom & Sandberg, 2009: 311) classified as a human enhancement. Neurotechnological enhancement of humans and the integration of BCI to the organism may create an entirely novel form of functions of an organism. For example, BCI could supplement and replace sensual functions, motoric functions, communication functions and cognitive functions of biological organisms, which would create a selection pressure for more innovative exorganic adaptations. Complex interactions between these diverse exorganic adaptations and altered forms of differently enhanced organism could bring about composite systems of integrated functions, which could be classified as exorganic post-species, or posthumans. The possibilities of various integration of BCI to organisms are almost endless. BCI could bridge the gap between different organisms, between the biological and synthetic, between the limitation of mind, matter, and functions. In this sense, BCI could be seen as an all-round tool for purposes of futuristic exorganic visions.

The conceptual working point of BCI is, however, not just futuristic, or entirely new. In theory, the idea is very simple and old. Read the mind and then take action, rewrite the mind, or construct the mind. Theoretical precursors for BCI was the discovery of measurements and readings of electrical signals in brains of animals in the year 1875 by R. Canton (Kolhe, Khemani, Bhatt, & Dubey, 2018: 226). Canton used specially modified galvanometer to monitor the electrical brain activity of monkeys, cats, and other animals. This work was inspiration for H. Berger who began working with human patients. For experiments with human patients, Berger needed new experimental settings and electronic systems. Berger, therefore, constructed a new and more sensitive electro-device that enabled first recordings of the electrical activity of the human brain in the year 1924 (Kolhe et al., 2018: 226). For his invention of electroencephalograph (EEG), Berger is therefore sometimes credit as the forefather of BCI.

The ability to read the brain and his signal is, however, just the first step to BCI. The second necessarily step involves action. The first

precursors for implementation units of BCI were developed in the 1960s. Interestingly enough, the first basic implementation didn't come from science but the creative workings of art. Alvin Lucier's *Music for Solo Performer* for enormously amplified brain waves and percussion is often considered as an early example of a simulation of a BCI. In 1963 Lucier used EEG and analog signal processing hardware to control and stimulate acoustic percussion instruments (Straebel & Thoben, 2014: 17). The technical realization of this BCI was rudimentary and the control was more or less random according to the needs of the presented artwork. First real scientific realizations of BCIs were therefore focused on the correct translation of different brain wave patterns to the implementation unit. The implementation unit needs the right kind of logic architecture, and thus the term brain-computer interface was coined. The authorship of this naming convention is usually attributed to V. Vidal (Vidal, 1977). Vidal was also the author of the idea of the so-called BCI challenge. The BCI challenge simply consists in the contest for correct functional externalization of brain activity. The first results of an experiment that acquired the relevant control of objects purely by electronically mediated brain activity were published in 1977 (Vidal, 1977). The control was of a cursor-like graphical object on a computer screen. The demonstration of the successful BCI challenge was the movement of a cursor in a maze. This and other successful experiments started the research for the action potential of electro-mediated brain activity.

The next step for BCI was the realization, that the interface can be used not only to control external physical objects, but also the very same activity of the brain. After the action potential of BCI was theoretically proven and practically demonstrated the research moved to possible control aspects of BCI. The idea was to use the interface to correctly stimulate electrochemical brain activity, or to simulate electrochemical brain activity. Stimulation of electrochemical brain activity could be used to manage some internal functions of the human brain. Simulation of electrochemical brain activity could be used to restore some typical externalization functions of the human body. The first successful experiments went through in the 1970s. The experiments consisted of proof of the potential of BCI for sensorial recreation. Sensorial recreation was accomplished by simulation of brain functions, which establish the possibility of hearing. Restoration of brain function by stimulation using BCI was proven by mid-1980s (Gardner, 2013: 712). This and other experimental proofs of concept of BCI marked the date for the first wave of therapeutic and commercial uses of BCI, which are hailed by many proponents of exorganic posthumanism (Warwick, 2017).

3. Therapeutic and nontherapeutic use of BCI

Modern-day BCI can be differentiated by many conceptual categories. The various categorical classification can range from the categorical goal of the relevant BCI (e.g. sensory restoration, motor restoration, enhancement), through the category of integration (internal or semi-external BCI), to the category of the relevant BCI procedure (e.g. invasive, non-invasive procedure of BCI). These all categories, however, depend on the actual usage of the relevant BCI. In the broadest application sense, BCIs are nowadays mainly medical devices. The conceptual clarification (and problems of conceptual clarification) of BCI for exorganic posthumanism is therefore largely tied to the current therapeutic usage of BCI.

One of the first successful therapeutic devices that utilized the BCI system was neurostimulation technology for the treatment of Parkinson's disease. The BCI function was to correctly guide electrochemical signals and the brain activity of the patient. In this regard, the relevant BCI was an internal assistance device for control of some of the typical symptoms of Parkinson's disease. These BCIs were using neuromodulation techniques to directly alter brain activity following the respective quantitative therapeutic requirements. The goal was to effectively stimulate neuronal activity which could lead to a decrease or increase in brain, motoric or other functions (deep brain stimulation). This type of stimulation is regulated within the BCI delivery of low voltage electrical signals to a certain part of the brain. The exact mechanism of the action of BCI stimulation is not known, however, it is believed that it can lead to the desynchronization of abnormal oscillatory activity of neurons (Shih et al., 2012: 270).

This kind of BCIs are nowadays routinely used for the treatment of Parkinson's disease, essential tremor, intractable pain, dystonia, obsessive-compulsive disorder and depression (Gardner, 2013: 708). Current research is focused on possible clinical usage in the treatment of anorexia, addiction and wide range of other psychological disorders (Gardner, 2013: 708). Some authors even speculate that BCIs should be used not only for therapeutic reasons but also for the guidance of various social and personality characteristics (Gardner, 2013: 709). The clinical use of modern BCI is well established and well researched. However, this kind of BCIs have one grave disadvantage when it comes to the goal of enhancement of brain activity. Old generation of BCIs are exclusively unidirectional devices. The signal of the BCI is directed only by preprogrammed instructions for the BCI. The enhancement effect and transformation use of this BCI is therefore very

rudimentary. The BCI cannot reflectively react to different dynamic aspects of the brain. BCIs of this kind are therefore only useful for basic and simple tasks, which are not suitable for advanced modifications of biological organisms. In some settings, this kind of basic cognitive, or motoric assistance can be useful (e.g. treatment of the relevant neurological disease), but in many other more speculative cases their usefulness is limited.

Current research of BCI is focused on the problem of the multifunctional use of BCI. Predictive analytics and artificial intelligence could be used to greatly enhance the learning capabilities of the BCI, and hence the multifunctional output of the BCI. Advanced predictive analytics and artificial intelligence could link internal (brain) and external factors (environment) in a new and direct functional way. The problem mostly lays in the correct technological conversion between these two very different domains of the whole interface, but if the signals are in some technologically meaningful way translatable than the BCI would be fully multifunctional. Electrochemical outputs of the brain would be directly converted to environmental outputs through the advanced BCI. The organism could therefore theoretically control any digital, or electro-mechanical devices. And the causation could be also reversed. Different real or virtual environmental inputs could mediate different electrochemical reactions of the brain by the advanced BCI. This BCI would, therefore, facilitate full and multifunctional direct real-time internal-external connections. This advanced BCI would also meet the definitions of the so-called complete complex interface. Communication (in the broad technical sense) could be maintained in all directions and paths of the loop of the BCI. It is not surprising that this advanced BCI could be used not only for many different therapeutic purposes but also for many various nontherapeutic means. The learning ability of the BCI and his multidirectional connections to real or virtual environments (cloud) could be used in radical human improvement. The examples can range from communication mediations, external object manipulation, attention stimulation, motoric assistance and guidance, memory recollection, sensorial enhancement, problem-solving, spatial assistance, decision making, to the possibility of the brain to brain communication and complex environmental operations. The first steps on this exorganic path have been already taken. Some experiments show, that BCI can be used to directly improve performance in spatial memory, working memory, and even decision making (Coffman, Clark, & Parasuraman, 2014). Some other technologies that could be adapted to the advanced BCI are showing promising results in improvement of visual search and exploration. Experiments with animal models have also shown,

that advanced BCI could in principle enable direct brain to brain communication, which could lead to enhanced solutions of some spatial and motoric tasks. This means that in theory the technological feasibility of direct real-time sharing of information could be also used for sharing of acquired knowledge (Pais-Vieira et al., 2013). The current uses, experiments and the principal model of BCI, therefore, give rise to speculations about future improvements of BCI, which could be used not only for human enhancement but also for exorganic posthuman adaptations (Warwick, 2017). BCI are already seen as technologies that could one day merge human and artificial intelligence, thus creating a new model of intellect or a new exorganic posthuman species. Posthumanism speculations about radical enhancement by radical cyborgization of humans may be currently farfetched, but this doesn't change the fact that some technologies which could be integrated into BCI can in some cases already enhance different cognitive tasks. The problem of BCI and posthumanism, however, lay not only in the assessment of future technological advancements, or in the plasticity of neuronal activity of the brain, but also in the assessment of the actual and future permissible uses of BCI.

4. Bioethical problems of BCI

The relation of BCIs to humans is different from many other types of technologies. The first problem of BCIs is linked with their integration to the human body and mind. The integration is direct and intimate. If the BCI works then the BCI is in some sense an integral part of the organism and the functions of the organisms. This means that the BCI can be seen as a technology that alters human identity and human agency. And this isn't just theoretical speculation. BCIs that are used for the treatment of neurological disorders have been shown to produce some changes in self-identification of some patients. For example, some patients that used BCIs for treatment of Parkinson's disease have expressed reservations about identifying with their condition before the use of BCIs (Clausen, 2010: 1155). There are also known minor cases of side effects of the usage of older versions of BCIs. Some researchers reported different and progressive changes of the personal characteristic of some patients that were using neurostimulation devices. The symptoms included loss of social control, hypersexuality, compulsive disorders, cognition alterations and aggression (Clausen, 2010: 1159). Such cases can be seen as prime examples of procedures, or technologies that can directly endanger personal identity. If BCIs would typically have only such personal consequences, then the use of BCIs wouldn't be permissible in any

case. However, here also lies the main problem with the personal identity argument against BCIs. The described symptoms and changes aren't common side effects of the procedure or the properly working BCI. This means that the effects aren't intended and are just results of technological complications of some of the systems of the relevant BCI. From a practical point of view, this argument, therefore, doesn't point to the conceptual problem of BCI, but technological problems and problematic uses of some older versions of BCIs. In the aforementioned cases, the BCIs weren't functioning properly. As with any other technology BCI would be permissible only, if the overall beneficial impact would be greater, than some of its unintended and corrupted consequences. The reality is that currently there are millions of patients that use BCIs for treatment of their respective neurological diseases. These diseases can have severe and debilitating effects on the patient. A blanket ban of BCIs motivated by this argument could therefore paradoxically lead to the endangering of the personal identity of all of these patients.

Maybe the problem isn't just in some unintended changes to personality that can result from the usage of not properly working BCIs. Working BCIs could also lead to consequences that can endanger the personality of the user by limiting the choices of this user. BCIs are after all devices that can directly monitor and control brain activity of the user. This means that BCIs are devices that could limit some aspects that are required for personal autonomy. The argument against BCI states that all neurotechnological interventions into the brain are potentially dangerous, because they may control, and therefore exclude autonomous decisions of the human. The perfectly working machine (BCI) would directly control the human, and the human, therefore, wouldn't be free and autonomous. This argument has it right. It should be always assumed that, if BCIs are used to manipulate the brain activity of a human who doesn't agree to the use of BCI, then the use of the BCI is unacceptable. In-voluntary use of BCI should be strictly prohibited in all cases. On the other hand, this doesn't mean that the voluntary use of BCI should be also prohibited. The conceptual ambiguity is linked with the problem of the automation of information processing for therapeutic uses of BCI. In some therapeutic settings brain activity of patients is automatically maintained by the BCI device. This could mean that in some case voluntary use of BCI and voluntary limitations of autonomy could be of beneficial use for the patient. However, the situation of patients using BCI can be also seen from a very different perspective. For the patient, the voluntary use of BCI doesn't undermine but enhance his autonomy. The properly working BCI just

maintains the needed neurological baseline of the patient for choices, which couldn't be acquired if the patient didn't use the BCI. Voluntary use of BCI for therapeutic, but also enhancement uses could, therefore, increase some aspects of autonomy. The ability to control and improve cognitive, motoric and other functions by BCIs implies, that this technology could be used for new kinds of autonomy acquisitions. However, this doesn't mean that BCIs can't be misused. The misappropriate use of the control aspect of a BCI is simple that, what is it, a misuse.

The third problem of BCI is connected with the observation modalities of the system of BCI. BCIs need to monitor and reflect information about the brain activity of the relevant user. Thus, BCI can raise concerns about the topic of privacy. In some aspect, BCI has the potential to access and read the mind, or thought activity of the user of the BCI, but this doesn't mean that current BCIs are really reading the mind. All that these devices do is an interpretation of some electrochemical brain signals in language that is understandable and translatable into instructions for the processing unit of the BCI. Correct and effective interpretation of these signals is the main challenge for the forthcoming age of advanced BCIs. This so-called problem of decoding brain patterns isn't the only topic that is relevant and related to privacy. The other problem is related to the acquisition of the data. The relevant question is very simple. Who is the owner of the coded or decoded information about the relevant activity and functions of the brain? BCI could dramatically shift the state of this ownership. This has biological, but also other reasons. Brain activity isn't uniform and brain activity isn't directed by a simple repetitious or simple static pattern. The prospect of effective decoding of the brain patterns is therefore crucially dependent on the needs for large amounts of brain activity data, which will be systematically analyzed and compared. The requirement for large sets of analyzed data naturally leads to different claims and possibilities for the ownership of the relevant information. Successful use of BCIs therefore crucially depends on new privacy standards and settings for brain activity data. This doesn't mean that this information should be public, or privately owned by commercial or noncommercial entities. We are not in the dark in here. Collection of sensitive personal data are of regular use in the field of practical medicine. Some of the regulations, such as informed consent, could be translated into strict protocols for non-commercial and commercial uses of information capabilities of current and future BCIs.

The fourth problem is linked with the classical distinction between therapeutic and non-therapeutic use of BCI. In theory, the line is pretty

straightforward. Procedures that cross the line of restoration of normal human functions are ordinarily seen as enhancement. The problem with this distinction is that some BCIs already cross, or can cross this line in many different aspects. For example restoration of some sensory inputs can be seen as a classic case of the therapeutic use of BCI. The required sensory inputs of the BCI are mediated through electronic means (sensors) which of course aren't identical with normal sensory inputs. From this point of view, the BCI doesn't just restore the normal sensory input, but also adds a brand new bioelectric sensor that just mimics some aspects of the biological sense. In this broad sense all BCIs don't just restore, but mainly differently substitute some functions. This doesn't mean that BCIs can be used only for transhumanistic or posthumanistic uses. Substitution can be in some cases seen as a form of therapy, but in other cases substitution can be also seen as replacement technology, which doesn't comfort to the ordinary pre-conceptual notions of boundaries between normal and abnormal functions and uses.

The problem isn't just in some vague and anachronistic conceptual ideas about therapy. The fifth problem with BCIs is the conceptual problem of BCI use for enhancement. On its own enhancement isn't a clear cut concept either. There are many definitions of enhancement, which can be seen in various and disputable ways. For example, the classical definition of cognitive enhancement comes from N. Bostrom and A. Sandberg (2009). According to Bostrom and Sandberg (2009: 312), cognitive enhancement may be defined as the amplification or extension of core capacities of the mind through improvement or augmentation of internal or external information processing systems. Bostrom and Sandberg (2009: 312) are explicitly stating, that information technologies could be used for enhancement. This surely could be the case for specific information devices such as BCIs. Some BCIs already can, or soon could change (replace) some of the processes that internally augment information processing. The problem with this and other similar definitions of enhancement is that they are generally too broad for the technological, conceptual and philosophical aspects of BCIs. Not all results of augmentation of information processing of the human mind are necessarily implying enhancement by technological means. For example, the augmentation of the mind can be also achieved through classical pedagogical assistance. Amplification of the core capacities of the human mind can be seen as the essential ideal of any good teaching. Yet, it is very doubtful that any ordinary person would see teachers as biological cognitive enhancing devices that march the way toward

posthumanism. Teachers are not BCIs, but the problem with radical posthuman enhancement goes also conceptually deeper.

As we have seen BCIs can (or could) be used for modification in many fields of human and posthuman inquiry. BCIs are already used in enhancing memory recollection and could be used for many different aspects of subsistence in human or posthuman cognition. In this sense, it is also true to say, that BCIs indeed are not enhancement technologies per se (as some proponents point), but extended guiding tools for some possibilities that are commonly implied and assumed in the exorganic posthumanism project. The exorganic posthuman project, however, isn't just an ideology that arguments for some possible future technologies (e.g. radical cognitive enhancement). The exorganic posthuman project is driven by the quest to deconstruct nature's own errors. Every technology is enhancement only in that case if nature and human biology are in some way corrupt. According to this line of reasoning of exorganic posthumanism, the weakness of human biology is the reason for humans to use technology. All (good) technology is seen as a form of liberation from our deeply problematic natures, and therefore all technology is enhancement. The exorganic posthuman movement is thus motivated also by the pessimistic view about standard human functions, and distrust in ordinary ways and modes of biological human lives. That doesn't mean that exorganic posthumanism is straightforwardly false, or unacceptable. In the end pessimism about human nature could be also seen as realism about human nature. The problem with the typical enhancement ideology is that this pessimism is in many cases only overwritten by optimistic rationalization of future technologies, such as BCIs. Doubtful rationalization of the results of some prospective technologies could lead to irrational public assessment of these technologies. BCI are (and could) be used for good purposes not only then, if they somehow manage to rearrange negative aspects of nature of human biology and lead to posthumans, but also then if they just help to improve some aspects of humans. The debate about enhancement and consequently about the nature of humans is therefore in some sense irrelevant to the problem of BCI usefulness. Or to put it in another way, BCIs are transformative technologies, but that doesn't imply that they are necessarily posthumanistic technologies. For what they are, they could be also used as humanizing technologies. BCI could just improve the processes of acquiring and generating new human knowledge. In this respect, BCIs are (or could be) more new versions of the broad category of humanizing assistance technologies.

5. Conclusion

BCI technologies are new and innovative tools for different integrative features and applications, which could combine biological and non-biological functions of organisms. The complexity of these interactions could lead to new forms of unique posthuman functions. Exorganic posthumanism reasons for these new synthetic, electronic, physical and digital functions of future posthuman beings. Fuelled by this prospect several debates about BCIs are dedicated to the search for a total and ultimate goal of this technology. It isn't very surprising that the predictions about the future uses of BCIs aren't based only on the knowledge of the technology and the science behind BCIs. Explicit assumptions about advances in neuroscience sometimes go hand in hand with implicit assumptions about the future of transhuman and posthuman modes of society.

As has been shown BCIs are nowadays mostly medical and therapeutic devices. Effective therapeutic use of current BCIs doesn't certainly imply, that it's necessary to prepare for a future where every enhancement with BCIs is just a mode of advanced posthuman therapy. It should be also noted, that the possible future use of BCIs for goals of exorganic posthumanism doesn't necessarily entail, that the future usages of BCI will be good, beneficial, or even socially acceptable. The main problem with the so-called human and posthuman enhancement idea is that this concept isn't, rather paradoxically, enhancing the debate about the future applications of BCIs, because improvements and modifications with BCIs are mainly value and predictive neutral. Current BCIs are therefore under similar conceptual and ethical ambiguity, like some other transformative technologies of posthumanism. Granted, in some situations and by some means every usage of BCI could lead to successful, but also unsuccessful posthuman modes of being. So, in the end, the theoretical assessment sum of future BCIs stays always the same. The result stays always in the hypothetical exorganic posthuman future. That, which isn't abstract and neutral is the actual suffering of present people. And this should have our primary and outmost attention also regarding bioethical and philosophical assessment of the current use of BCIs.

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