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ORIGINAL RESEARCH PAPER

The Presentation of Brain-computer Interfaces As Autonomy-enhancing Therapy Products

A Mechanism to Promote Societal Acceptance of Implant Technologies

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Abstract This paper explores the societal and individual acceptance of technologies for the human body, focusing on brain-computer interfaces (BCIs), particularly Elon Musk's Neuralink. BCIs promise a direct connection between the brain and computers. Their acceptance depends on general aspects such as feasibility and usefulness. In the case of brain implants, they should also not jeopardize the user's autonomy or have a dehumanizing effect. In the case of innovative technologies that are still in development, such as BCIs, acceptance depends largely on their public relation presentation. The article uses the case of Neuralink to analyze how new technologies for human bodies, and specifically BCIs, are presented as acceptable technologies. Analyzing Neuralink's public relations communication, the study reveals how the company constructs a vision of a plausible and desirable future, countering skepticism often associated with science fiction tropes. The article emphasizes the relevance of the categorization of BCIs and shows how the presentation of BCI as an autonomy-enhancing therapy product can positively influence the acceptability of the technology. By addressing key topics of ethical discourse, such as autonomy and identity, Neuralink attempts to create social acceptance for its innovative but controversial BCI technology. The results contribute to the understanding of the complicated dynamics between technological development, public relations, and societal values.

Keywords Brain-computer interfaces · Innovative technology · Technology acceptance · PR communication · Neuralink

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Introduction

In recent decades, brain-computer interfaces (BCIs) have emerged as a burgeoning domain within the realm of technology development for the human body. BCIs are supposed to make it possible to control computers with thoughts. Alongside companies like Blackrock Neurotech, BrainGate, and Synchron, Elon Musk's Neuralink is one of the companies working on such a BCI [1–4]. They want to develop a chip implant that will enable a permanent connection between brain and computer. As Neuralink [3] claims, „[w]e're designing the first neural implant that will let you control a computer or mobile device anywhere you go." For this purpose, they aim to implant a chip in the skull bone. The chip's wires are to be woven into the brain next to the neurons. Bluetooth should be used to connect the BCI to a smartphone app that should enable the pairing of the chip and the end device that is to be controlled.

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Technologies for human bodies, such as wearables, prostheses, and implants, need acceptance: on the societal level as well as by individual subjects as potential users [5]. Societal acceptance refers to the collective approval of a particular technology within a broader community or society. Subjective acceptance, on the other hand, is related to the personal attitudes of individual users toward a specific technology. If technologies are already established, they usually fulfill the first criterion of societal acceptance. In this case, the primary question is how the acceptance of the individual subject can be guaranteed [6]. In contrast, for new, nonestablished, speculative technologies the question of societal acceptability often arises as a matter of priority. Acceptability by the subject appears to be of secondary importance if societal acceptability determines which technologies are even permitted for research, development, and production [7]. This is especially the case with invasive technologies such as BCIs, whose application requires harming the body in order to improve it.

The level of societal acceptability is reflected in public discourse or legislative regulatory practices regarding the use of technologies [5, 8]. At the same time, these also reveal potential crises in the acceptance of the technologies. In this respect, it is noticeable that BCIs are repeatedly associated with science fiction in media coverage. In media reports on Neuralink, for example, it is said:

> This week Elon Musk unveiled his most sci-fi project thus far. [9]
> Between medical revolution and science fiction: Elon Musk wants to transfer thoughts to the computer with Neuralink. [10, transl. T. Garbe]
> It sounds like the plot of a science fiction movie. Tesla boss Elon Musk (50) wants to turn fiction into reality. [11, transl. T. Garbe]

These references to science fiction implicitly question the framing of BCIs as a feasible and desirable future. Science fiction often focuses on technological possibilities and their consequences [12]. The technological modification of bodies is primarily associated with human enhancement or the development of transhuman beings [13]. Such narratives thereby function as metaphors to reflect present conditions. They are usually not intended as visions of the future to be aspired to, but rather often contain negative assessments of the depicted developments. If a BCI is associated with science fiction, this indicates that the technology is not readily considered possible or clearly desirable [14]. The comparison with science fiction points in the direction of already identified criteria for technology acceptance. Technologies always raise the question of feasibility. Particularly regarding subjective acceptance, questions about the simplicity of use and the perception of use prevail [15]. In line with the issue of whether they are a desirable future is the question of which applications a technology should be made for at all (e.g., differentiated by therapy and enhancement), as well as ethical questions including how they affect the autonomy of users and their identity, the anthropological self-understanding, and the relationship between humans and technology [8, 16, 17].[1]

This paper uses the Neuralink case as an „empirically grown breaching experiment" [18] to ask how new, speculative technologies for the body, and especially implantable BCIs, are evaluated as acceptable body modifications.

Since these technologies are still in development, their evaluation heavily depends on the framing of PR presentation by the companies. The aspects that potentially jeopardize acceptance thereby become reference problems of PR communication. PR presentations serve to create a positive image of the company to its stakeholders and to influence their opinions [19]. To create such a positive portrayal, PR communication must consider the expectations of its recipients [20, 21]. The self-representations thereby reflect the company's expectations about the expectations of its audience. The presentation of the company and the ideas that recipients have about it are thus interrelated. Although a company's media self-representation does not indicate how its technology is evaluated by the public, it provides insight into what the company assumes is a legitimate interpretation of its BCI. By analyzing PR communication, it is possible to deduce expectations about intersubjectively shared values, norms, or notions of legitimacy. The data basis of the Neuralink case study is composed of video recordings of the launch event in 2019 [1] and of the update event in 2020 [2] as well as the 2021 version of the company's website [3].

[1] In the case of Neuralink, all these concerns are also reflected in the numerous critical expert opinions in the media.

In its PR presentation, Neuralink portrays its BCI as an autonomy-enhancing therapy product of the near future. While it seems self-evident when looking retrospectively at established technologies that technologies for the human body increase autonomy and invasive technologies are only approved as therapy products, the case analysis will be used to reconstruct the notion that, while no technology increases autonomy or is therapeutic per se, they can be framed in this way. The paper thereby shares the perspective of the concept of sociotechnical imaginaries [22], which implies that the acceptance of technology always depends on its embedding in cultural imaginaries. The analysis thus points to a blind spot in the debate about the acceptability of technologies for human bodies. Most debates focus directly on „the acceptance of enhancement products" or „the acceptance of therapy products." They ignore the fact that these interpretations have already set crucial courses for the acceptability of technologies and may be accordingly used in PR communication. In this paper, it is shown that the categorization as a therapy product relies primarily on a construction of 'physical deficits' as problem to be solved. The appearance of increasing autonomy depends primarily on the underlying interpretation of the human-technology relation. It will become clear how these contingent interpretations are instrumentalized in the PR communication of Neuralink to generate acceptability by providing a response to critical issues such as feasibility, autonomy, and identity. This is especially relevant for debates that decide how society deals with technological developments.

In the following, this paper first gives an overview of the reference problems of PR presentation (2). After that, it reconstructs how Neuralink tries to portray its BCI as a plausible future and thus opposes the criticism of being only fiction (3.1). Afterwards, the paper elaborates how the BCI is presented as a desirable future for human beings by categorizing it as a therapy product (3.2) and as an autonomy-enhancing device (3.3). Finally, the paper reflects on how presenting the BCI as an autonomy-enhancing therapy product of the near future can be understood as a mechanism to promote societal acceptance (4) and what further conclusions can be drawn about the interaction of technology development and value development (5). While the empirical analysis was conducted under the premise of axiological neutrality, a critical perspective on the presentation of Neuralink is adopted in the conclusion.

Acceptance for Technologies – Reference Problems of PR

Subjective and societal acceptance for technologies depends on the assessment of various aspects, which therefore become the reference problem of PR. In general, the acceptance of technologies is influenced by its perceived feasibility and usefulness. The expected ease of use, subjective attitudes toward technologies, and sociodemographic variables are especially relevant for acceptance by the individual – as shown in the Technology Acceptance Model (TAM) by Davis and Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. [6, 15, 23, 24]. In the case of invasive technologies such as implants, a more specific analysis of the risk–benefit ratio for the individual and society is additionally carried out [7, 25]. Technology should produce an improvement that outweighs the harm caused by the invasive procedure. This leads to implantable technologies being located and approved almost exclusively in the medical context, where 'physical deficits' will be corrected.[2] The fact that the development of invasive technologies is already strongly regulated by legislation reflects a special understanding of the human body as being worth protecting.

In addition to the usual consideration of improvements and damages due to the value placed on the body, it is becoming apparent that in the case of interventions in the brain, the brain is also attributed a special position. In debates about brain pacemakers, ethical questions are raised regarding the brain „as a carrier of individuality and personal ego experience " [25, p. 119, transl. T. Garbe]. Discussions are taking place about the extent to which brain implants interfere with the identity of their users in a personality-altering way, and how they monitor and externally control them, thereby endangering their autonomy [6–8, 16, 17, 26–28]. Additionally, the question arises as to the extent to which technologies such as implantable BCIs could be used for human enhancement. Following this, it is stated that „[t]he

[2] Exceptions are implants in the body hacking scene.

incorporation of technological devices in the brain challenges the classical conception of the human being “ [25, p. 119, transl. T. Garbe].

If the assessments of feasibility, usefulness, simplicity of use, and non/harmfulness, the contextualization in therapy or enhancement, and the assessment of the influence on identity, autonomy, and the conception of human beings have an influence on the acceptance of technologies, these aspects represent reference problems for PR, particularly in the case of technologies that do not yet exist. PR must achieve a presentation that helps the technology gain acceptability beforehand, so that it is even approved for development by the authorities.

Companies working on technologies for the human body react to the reference problems of PR. In this paper, three key aspects are brought into focus. As current BCI projects are regularly compared to science fiction, companies first must present their BCIs as a feasible future instead of pure fiction. In addition, they must choose a framing that classifies the intervention in the body as therapy or enhancement, and as autonomy-enhancing rather than autonomy-threatening by choosing a specific interpretation of the human-technology relation. Before examining how Neuralink presents its BCI (Sect. "The presentation of a brain implant as an acceptable technology"), it is important to understand why the categorization as a future or fiction, as therapy or enhancement, and as autonomy-enhancing or autonomy-threatening can influence the acceptability of technologies for the body.[3]

Future or Fiction

Because BCIs are the subject of both fictional narratives and current research projects, they oscillate in their categorization between a fiction of an alternative world and a draft of the future. Both fictions of alternative worlds and futures are imaginaries in the present [29, 30]. They are interpreted as currently not real and are differentiated as designed presents from the design present. Imaginations thus make it possible to extend the actual by a currently inactual. Their production requires a doubling of the present through sign systems such as languages, symbols, or visualizations in which the nonactual takes place [31–34]. What distinguishes fictions of alternative worlds from drafts of futures is their relationship to the current present. While a fiction forms a parallel alternative world, futures are positioned as a follow-up to the present. Both require marking the deviation from the current present, so that the described world is not interpreted as a description of the present. In addition to establishing the deviation, futures must also demonstrate an ability to link up with the present. If it is not made plausible how a drafted future connects to the present, the future reverts to the status of a fictional, alternative world. In that sense, fictions of alternative worlds are the pre-stage to the production of a future, and futures in turn are a subform of fictions [35–38]. The futurizing moment is the locating of fiction as a follow-up to the present. The futurity of futures is thus a fragile construct. To demonstrate evidence of connectivity, futures are repeatedly presented as partially present. Thus, the use of prototypes signals feasibility and nearness [29, 35, 39–42]. The danger for futures in being only fiction concerns technological developments, especially if they were already established as a novum in science fiction (e.g., air taxes or BCIs). A novum in science fiction serves precisely as a marker of difference from the present [12]. In the case of BCIs, the Un/Doing Future [43] therefore oscillates more strongly than in the case of developments that are not familiar from science fiction, because from outside, accusations are repeatedly actualized that this is only fiction.

Therapy or Enhancement

The categorization of a technology as therapy or enhancement is not determined by the technology itself. First, technologies can be used for different goals. Second, the distinction between therapy and enhancement is culturally contingent. If therapy and enhancement are defined as in everyday life, therapy is what serves to prevent or cure disease [44]. Enhancement is „the use of pharmacological, surgical, or biotechnical interventions to beautify, improve, or enhance the performance of healthy individuals – i.e., beyond disease alleviation, cure, or prevention “ [45, p. 99, transl. T. Garbe]. But what counts as a healthy or diseased body is variable [46–48]. Therapy

[3] Besides the issues discussed here, each company must address additional, individual reference problems. These cannot be examined in detail at this point.

and enhancement are therefore better described as different logics of body modification [49], distinguished by their orientation to a current 'normal human body' [48, 50, 51] as a fixed point. Therapy and enhancement share the intention to improve a body in its current state. Therapy is defined as interventions for bodies that have been interpreted as 'deficient' and are to be brought closer to a 'normal' body. Enhancement takes a 'normal' body as a starting point and describes the increase of good characteristics (e.g., for competitive advantages on the job or dating market). What is culturally considered a 'normal' body remains a question of negotiation [52]. Regardless of its current definition, therapy describes the orientation towards the 'normal' body, while enhancement refers to an orientation away from it [49]. Therapy describes body modifications as a shift from a deviation to the norm. Enhancement describes modifications as a shift from a norm to a desired, positively connoted deviation through an exaggerated expansion of the good. In this context, enhancement may well produce new norms – as in the case of cosmetic surgery – and bodies previously considered 'normal' appear to need treatment [53]. But because enhancement initially leads away from a 'normal' body, it can also generate uncertainty, which can have a negative impact on acceptability. In contrast, body modification framed as therapy appears legitimate and desirable in a society that still promotes the idea that it is up to the 'deviant' individual to conform to the norm (known as the medical model) [52].

Autonomy-enhancing or Autonomy-threatening

The assessment of the influence of BCIs on the autonomy of the user depends above all on the understanding of the human-technology relationship. Autonomy, in contrast to heteronomy, means the ability of an agent to act without being controlled or directed by external agents. Humans have always made use of technology to survive [54]. Accordingly, being human means needing technology. Since humans are always dependent on technologies in their actions, the evaluation of the autonomy of technology users is rather a matter of attributing to them the ability to act in a self-determined manner.

In anthropocentric worldviews, the interpretation is inherent that technology is subordinate to humans as an aid [55, 56]. By attributing control over tools and machines to humans, they are conceptualized as acting agents. In this understanding, technology brings autonomy to humans because it opens up possibilities for them without taking away their self-determination. A loss of human autonomy, on the other hand, is threatened when technology is ascribed as an autonomous actor itself. Complex machines, humanoid robots, and artificial intelligence systems are repeatedly positioned as counterparts of humans by making assumptions of similarity [57]. They are compared to humans in their capabilities and used as interaction partners [58]. The human-technology relationship, which has located technology below the human being, is thus called into question. Instead, there is the possibility that the relationship between humans and technology is reversed and technology controls humans. Another risk to the autonomy of users is that people could become controllable by other agents through technological interfaces. In this case, technology is not conceived as a counterpart of the human being but as an open gap in the body that makes the human being no longer appear as a closed unit [59, 60].

After outlining the background of the reference problems of PR communication for BCIs – feasible future or fiction, therapy or enhancement, promotion of autonomy or loss of autonomy – the following section will use the ambiguous case of Neuralink to analyze how an implantable BCI is created in PR representations as an acceptable technology for human bodies.

The Presentation of a Brain Implant as an Acceptable Technology

Neuralink's PR material was examined using qualitative content analysis [61]. The data is based on three elementary parts of the PR communication: a video recording of the presentation at the Neuralink launch event in 2019 [1] and the presentation of the follow-up event in 2020 [2], both of which were subsequently shared on Neuralink's YouTube channel, as well as the complete company website (as of 2021) [3]. The aim was to examine communication components of the product presentations for their contribution to the presentation of an acceptable BCI. For this purpose, the data material was first openly coded and interpreted inspired by grounded theory [62] for the

purpose of inductive category building. The developed categories were systematized with the help of the theoretical assumptions (Sect. "Acceptance for technologies – reference problems of PR"). The material was then systematically coded to condense the reconstruction of the three central aspects. In addition to the content analysis, the form of presentation was reflected from an ethnomethodological perspective as 'doing PR communication'. This serves to take into account the fact that the material comprises normative representations of BCIs. The following three sections are dedicated separately to reconstructing how Neuralink is creating its BCI as a feasible future, a desirable therapy product, and an autonomy enhancer.

Desirable Future Instead of Fiction

Neuralink presents its implantable BCI as the near future, distinguishing itself from the attribution of being only fiction. This distinction begins with the use of the category „future." „So creating a well-aligned future, that's the idea" [1]. However, the use of the label „future" and many phrases in the future tense is a relatively fragile form of differentiating fictions.

To ensure that the future draft does not fall back to the level of general fictions, Neuralink is working on a presentation in which the BCI is portrayed as a plausible follow-up to the present. By simulating feasibility, they try to convince the audience of the technology's ability to connect to the present. This is done parallel to outlining the divergence from the present by emphasizing the new and innovative moment. At both the 2019 launch event and the 2020 update event, Elon Musk and Neuralink employees talked about both previous and planned steps in the development of their product. The completed steps are demonstrated by prototypes. At the 2019 event, a photo was shown that depicts four artifacts lined up against a white background. The artifacts, made of various materials glued together, are similar to computer components. As one Neuralink employee commented, „[t]his is a photo of some of the prototypes we have gone through over that time. So we started on the far left" [1]. By lining up the artifacts in this way, Neuralink materialized the BCI development process in a form that was visually accessible to the recipient [63]. Other prototypes were pigs, which Elon Musk demonstrated in front of an audience in 2020. They were presented as animals from the company's animal experiments. One pig was described as wearing a chip implant in its head. It walked around in front of the audience in the paddock, with the audience hearing beeping sounds. Elon Musk explained that these were signals from the pig's brain, which were read out by the BCI in real time. The other pigs were described as having been formerly chipped. They should prove that BCIs can be implanted and removed 'without harming' the chipped living being. The pigs can be understood as prototypes in the sense that the chipped pig brain was not the actual final stage envisioned.[4] However, the chip prototype in the pig's brain is used to demonstrate to the audience that something was already working [39–41]. Neuralink stages that BCIs for humans are partially realized here and brought into a reachable future. Their storytelling raises optimistic expectations, which are essential "to mobilise the future into the present" [64].[5] [64] By telling the story of development with an outlook on the next steps, the still unreal future is anchored in the past and seems to unfold successively ever since.

While the completed steps are materially evidenced, the missing steps are presented in an extremely simplified form. For example, the implantation of the chip to the human brain is sketched in a graphic titled „GETTING THE LINK." The graphic shows four steps in which the skull is opened, the chip is implanted, and the wound is closed again. Elon Musk explains: „It's essentially you open a piece of skull, you remove about a coin-sized piece of skull and then the robot inserts the electrodes " [2]. The prediction for the procedure is that „the installation of a link [can be] done in under an hour. So you can basically go in in the morning and leave the hospital in the afternoon and it can be done without general anesthesia " [2]. In both presentations in 2019 and 2020 as well as on the company's website, it appears that Neuralink is ready and only awaits approval to take the next steps – tests on humans.

[4] Neuralink is regularly confronted with criticism regarding problematic animal testing. This could be another aspect that Neuralink is attempting to address with the pig demonstration.

[5] In the case of speculative future scenarios, these expectations can quickly become problematic, as they generate hype and are often set too high. This can lead to disillusionment when the expectations cannot be realized [64].

In addition to the demonstration of prototypes, another factor in establishing the BCI as a plausible future is that, at the personnel level, a constellation has been chosen that represents both feasibility and seriousness. Elon Musk does not present the BCI alone. In 2019 and 2020, he was accompanied by a group of employees who were supposed to represent various company departments and report on their work. This team presentation created further facts that were supposed to prove that the project was already underway. The employees stood for the already created infrastructure and were part of the ongoing realization. Additionally, they present themselves as experts in their respective fields. While Elon Musk, as a „billionaire of public life", talked like a prophet about his vision of the world to come, the unknown employees are used to convey down-to-earthness and symbolize real work instead of dreaming.

By presenting an existing idea of a new technology as well as prototypes and an infrastructure, Neuralink was constructing the events in 2019 and 2020 as a pitch presentation, which is typical for communication about innovative ideas [41]. Neuralink thus made use of a projective genre [65], which had an inherent future-constructive moment. Within the pitch, as in advertisements, they used the communicative form of the promise, which opens a temporal span between the moment of the promise and the moment when something does (not) happen. Another similarity to classic advertising communication is the use of addresses in the „you " form. In addition to the use of a generalized „you," „you " was repeatedly used to address the audience. Formulations such as „your brain " suggested, contrary to the fact that there was no finished product yet, that there was something that the listener could use. The idea presented in the pitch was brought closer to the present via „you " by placing it on a tangible horizon for the audience.

The presentation of Neuralink's BCI works with the ambivalent temporality that is common to the construction of a future. Futures are ambivalent constructs because they are designed by emphasizing deviations from the present and connections to the present at the same time [37, 38]. Relevant to the construction of a future is that something is not yet there, but may be there, and that is made credible by presenting something as partially there. BCIs in this sense oscillate between past and fiction to be understood as future. The prototypes were built in the past to present them in the present to make something plausible as future that is actually fiction.

If Neuralink interprets its BCI as future, the question arises of the extent to which the product also gets rid of its rather dystopian connotations, which are attached to it by its embedding in science fiction narratives. Neuralink therefore attempts to produce a positive reinterpretation as a desirable development. Instead of bleeding wounds, audiences of the 2019 and 2020 presentations got to see sterile, black-and-white drawings of heads and blue-glowing animations of neurons and „a healthy and happy pig " [2]. Visitors to the Website Saw Mostly Pastel Colors Until May 2023. Their Drawings With Rainbow Colors Were More Reminiscent of Modern Art Rather Than Science. In Addition to These Representational Elements, the Interpretation of the BCI As an Autonomy-enhancing Therapy Product Serves to Establish the BCI As a Desirable Future for Humans, Which Will Be Discussed in detail in the following two sections.

Therapy for 'Deficient' Bodies Instead of Human Enhancement

Neuralink interprets its BCI as a product for therapeutic contexts and thus contradicts the categorization in the spectrum of human enhancement. What is striking is that the company distinguishes a goal in a near future from a goal in a more distant future for its technology.

> These technologies create a new kind of brain interface that could help many people with neurological injury or disease. [3]
> So potentially with a device like this you could restore speech to a paralyzed person, who's no longer able to talk. [1]
> And if you can correct these signals you can solve everything from memory loss, hearing loss, blindness, paralysis, depression […]. [2]
> I've said a lot about AI over the years, but I think even in a benign AI scenario, we will be left behind […] I think with a high bandwidth brain-machine interface […] we can actually go along for the ride. And we can effectively have the option of merging with AI. [1]
> This [implant] I think has a very good purpose, which is to cure important diseases and ulti-

> mately to help secure humanity's future as a civilization relative to AI. [1]

They claim that their goal for the near future is to cure diseases. In the distant future, the goal is to improve humanity so that it can keep up with artificial intelligence. Interestingly, beyond these references to the distant future, the PR communication focuses predominantly on the goal in the near future. The BCI is thereby produced through various means of presentation as a medical product for therapeutic purposes. On a linguistic level, the terms "injury" or "disease" are repeatedly used, "people with neurological injuries or diseases" or "paralyzed people" are specified as the target group, and the goal is described as "restoring" or "correcting". The practices of correcting and restoring refer to the logic of therapy and also to the perspective of the medical model [52], which aims to bring 'deficient' bodies closer to the 'normal' body [49]. Disabilities such as paralysis are explicitly interpreted as a disease to be treated. The purpose of implantable BCIs – in Neuralink's interpretation – is to correct 'physical deficits' by restoring interrupted neural connections.

The linguistic categorization as a therapy product is supported by three further elements of presentation. First, Neuralink let a doctor in a doctor's coat appear in both the 2019 and 2020 events, who explained biological processes and the surgical procedure. In doing so, they made use of the elemental professional role of the medical system to anchor the BCI in that system [66]. Neuralink seeks to benefit from the positive attributes associated with the role of a physician. Second, Neuralink places its BCI in the history of other medical devices. A timeline is shown for this purpose.

> 1957 Cochlear implant […]
> 1997 Deep brain stimulation for Parkinson's
> 2002 First major demonstration of closed-loop brain-machine interfacing in monkeys […]
> 2013 Responsive neurostimulation for epilepsy. [1]

For the categorization in a history of medical technology developments, reference is made only to established technology or research successes, not to failures. It is suggested that Neuralink's BCI follows in the footsteps of these technologies, which at the same time means that it is not to be understood as a continuation of self-enhancement or leisure technologies. An exception at this point are the comparisons: „It's charged in the same way that you charge a smart watch or a phone. […] It's like a fitbit in your skull with tiny wires " [2]. However, the comparisons are less intended to place the BCI in their tradition, but rather to serve as explanations of modes of operation that are assumed to be familiar to the audience and thus inspire trust. Third, Neuralink repeatedly points out that they are guided in their development by the approval requirements of the U.S. Food and Drug Administration (FDA). The FDA is brought in as an external authority that controls the „safety, efficacy, and security of […] medical devices " [67]. Neuralink uses this reference to the FDA to present the BCI as a medical device by stating that the FDA is verifying that the BCI meets the criteria for medical devices – even if it is not clear to outsiders to what extent the FDA is actually examining the technology in detail.

This presentation of the BCI as a medical product adds to turning the BCI from fiction into the future. The BCI is embedded in the development line of other products and an established system. Neuralink's product categorization is thus explicitly oriented towards the current logic that brain implants have so far only been approved in a therapeutic context.

The goal of the distant future – to improve humanity to keep up with artificial intelligence – is remarkably less elaborated. It is projected onto a horizon as another possible area of application. Nevertheless, the question arises as to the extent to which the goal in the distant future is complementary or contrary to the main goal and thus a „dual use" issue exists [68]. Neuralink states that humans as a species will fall behind the capabilities of artificial intelligence and that BCIs are needed to counteract this. Unlike the first goal, this is not about treating individual humans, but a technological upgrade of the entire population. The whole of humanity is said to have a problem, whereby the term „benign […] scenario " is used that otherwise describes tumor diseases. The chip implant appears to be therapy for humanity. What is to be restored is the normal state of the anthropocentric worldview: the position of human beings as the crown of creation. Neuralink thus implicitly perpetuates the understanding that humans are dependent on securing their existence through the use of technology [54]. Accordingly, Neuralink speaks of a third level of the brain.

> Your limbic system is kind of your primal needs and wants, it's like where […] your emotions are coming from and then the cortex is like the thinking, planning part of your brain. And I haven't met anyone who […] wants to get rid of either the cortex or the limbic system. So clearly, they work together well; even though your cortex is in principle far smarter than your limbic system, everybody wants to keep the limbic system and their cortex. So hopefully we can have a tertiary layer, which is […] kind of a digital superintelligence layer. [1]

Regarding the distant future goal, they see the BCI as a further stage in the evolution of humans and securing humans in their position, not in any way producing a transhuman species and thus having dehumanizing consequences.

In addition to these descriptions as a therapy product – first for individuals, then for humanity –, it is noticeable that Neuralink does not contradict categorizations of BCIs as an enhancement product in unofficial statements. In Q&As, the response to corresponding questions is not negative, but positive.

> Audience question: „Can the Neuralink allow you to summon your tesla telepathically?"
> Elon Musk: „Definitely." [2]

The presentation of Neuralink's BCI seems to be ambiguous in parts. For official presentations, however, only the conservative interpretation as a therapy product for "people with neurological injuries or diseases" and the extended interpretation as a therapy product for humanity are used [69].[6]

Gaining Autonomy Instead of Losing Autonomy

Neuralink presents its BCI as gaining autonomy for individuals or humanity, contradicting speculations that user autonomy is in jeopardy. This interpretation is based on a continuation of the understanding that technology is subordinate to humans as body parts rather than an independent agent. The construction of the technology as a body part is done by placing the chip in the organism through a symmetrization of organic and inorganic parts, and by subordinating the chip to the human as the main agent.

For the symmetrization they use a specific description of both the brain and the chip implant. The brain is characterized primarily by the use of technical metaphors. It is seen as a:

> web of communication that allows you to move, think, feel and sense. […] Neurons send and receive information. Although neurons come in many different types, they generally have three parts: a dendrite which receives a signal, a cell body called a soma which computes the signal, and an axon which sends a signal out. [3]

Neuralink describes the brain as the hardware of information processing, thereby utilizing the typical analogy of the brain as a computer. Electrical signals are transmitted. They form the 'language' of communication between the neurons as nodes. The description of the brain as a network suggests that the brain is expandable since it can potentially be spun further. This is echoed by the description of the chip implant. Its materiality is described as filigree and adapted to the organic material. The dimensions of the chip make it possible to sink it into the skull.

> It's 23 mm by 8 mm. It actually fits quite nicely in your skull. Your skull is about 10 mm thick. […] It goes flush with your skull, it's invisible. [2]

According to Neuralink, the wires emanating from the chip to be placed next to neurons correspond to the size of those very neurons.

> The threads that we have […] are about the same size as a neuron. So, if you're gonna go stick something in your brain, you want it to not be giant. You want it to be tiny and to be approximately on a par with the things that are already there. [1]

If the brain is conceived as an extensible network, the materiality of the chip gives the impression of being a continuation of the neuron network. In addition to the material symmetrization of neurons and wires and skull bone and chip, Neuralink outlines that BCI and brain speak the same language.

[6] The fact that the framing as an enhancement product is not explicitly contradicted may also be due to Elon Musk's general alignment with the TESCREAL movement [69].

> Action potentials produce an electric field that spreads from the neuron and can be detected by placing electrodes nearby. [1]

Neurons and wires are said to be able to exchange information via the electrical signals.[7]

Parallel to the presentation of the technology as an artificial brain part, the subordination of the chip to the human being as the agent takes place. The BCI is not only presented as being able to function as a body part, but the use of the BCI is described analogously to the use of the organic body. After the chip is inserted, the individual would have to learn to control devices via the BCI. Being able to control the computer via thought is described using an analogy to playing an instrument [1]. After learning, the new ability is conceptualized as a function of the body available to the individual. Subsequently, the brain and BCI become a black box [70]. Neuralink promises:

> A Direct Link Between the Brain & Everyday Technology. [3]
> […] control your iOS device, keyboard and mouse directly with the activity of your brain, just by thinking about it. [3]

The step of signal transmission via the chip is not emphasized as a separate step, i.e. the chip is not singled out as an interface. Neuralink not only presents the BCI as physically integrated into the body but also into the human being as the main agent. Humans are credited with being the author of the action [7]. According to Neuralink, the brain could control everyday technologies „without a detour." It is said that people can use the functions of the BCI just like other functions of their brain or body.

In Neuralink's product presentation, the interpretation of BCIs as autonomy-enhancing interventions builds on this understanding of the relationship between humans and technology. This interpretation begins with emphasizing that the insertion of BCIs should be a voluntary modification [1]. The initial decision for or against a BCI is thus interpreted as an autonomous decision. If an implant were placed in the brain, the activity of the chip would be attributed to the individual. By portraying that it is always the human who acts, it is negated that the chip could lead a parasitic life of its own in the brain and manipulate its user. Instead, it is suggested that the human being is in control of the BCI and its functions.

> BE IN CONTROL The Neuralink app would guide you through exercises that teach you to control your device.
> BE AUTONOMOUS With a bluetooth connection, you would control any mouse or keyboard, and experience reality — unmediated and in high fidelity. [3]

Even the learning of the new body functions runs in an autonomous mode. The app is intended to make the user an autodidact and thus, as explicated at Neuralink's event in 2019, enable them to be independent of doctor's visits. A reference to the fact that the app is an iPhone application adds a connotation of security. Apps and devices from Apple are considered more tightly controlled than what is offered in the Google Play Store or devices from other brands. The implicit reference to the security standards that apply to Apple Store apps can be understood as an anticipated answer to the question of what is being done about potential hacking of BCIs. By portraying BCIs as artifacts that, like Apple products, are supposed to be hermetically sealed and as such are subservient to the user alone, the image of the human being as a closed entity is reproduced. Neuralink suggests that BCI users are self-sufficient, safe from intervention, and a closed system in itself. After learning the new body function – to control computers „unmediated" – the user's autonomy is interpreted as increased with the gain of new or regained possibilities of action.

Neuralink, using the example of the „paralyzed person," makes gaining autonomy the main aspect of the legitimization strategy for its brain implant when it presents BCIs as a therapy product for 'individuals with deficits'. Moreover, autonomy gain is also outlined for the more distant goal. If the chip is to be used as a therapy for a humanity becoming deficient, it stabilizes exactly that autonomy of humanity in relation to a dependence on artificial intelligence.

In all this outlining of an increase in autonomy, it almost goes unmentioned that BCIs create a new crucial dependency. It remains largely unspoken that the

[7] At this point, it should be reiterated that all these representations are part of PR communication. BCIs currently face significant challenges with reliable and detailed signal exchange. It is questionable whether Neuralink's announcements can actually be realized in the near future.

„new brain function" is dependent on power supply. If there is talk about charging the chip, then it is only in those references indicating that the BCI is to be charged like a smartphone. Therefore, „charging like a smartphone" is in no way interpreted as an autonomy problem, but rather as evidence of the simplicity of applicability for everyone.

Discussion of the Presentation as Acceptability Promotion

The extent to which this portrayal of BCIs as autonomy-enhancing therapy products of the near future has the potential to promote acceptability emerges from the theoretical implications of the distinctions between future and fiction, therapy and enhancement, and different human-technology relationships (Sect. "Acceptance for technologies – reference problems of PR").

Fictions of alternative worlds emphasize the difference to the present. They emphasize the unfamiliar and accentuate the discontinuity with the familiar [12, 13]. Although fictions serve to reflect on the current present considering the contrast of inactual possibilities, they also serve as critical thought experiments. As thought experiments, they are not expected or aspired to in the same way as future drafts [38]. This characteristic of fictions as unreal and undesirable possibilities can affect how technology is interpreted as something problematic.

Unlike fictions, futures are plausibilized as being connectable to the present [37, 38]. Therefore, they are presented as a continuation of known and established logics of the present. What appears to be a plausible future is new, but not completely alien. In this case study, the BCI is reinterpreted from an alienating novelty of science fiction to a technology that connects to the familiar. The acceptance that is given to the familiar can be transferred to the new technology as a continuation of the known. As a plausible future, the BCI can therefore expect more acceptance.

If a distinction is made between therapy and enhancement when categorizing body modifications, enhancement shows a greater potential for irritation regarding the use of invasive technologies. Enhancement does not have negative connotations per se. Rather, it is a manifestation of the maxims of a performance-oriented society. Nevertheless, enhancement practices are criticized for triggering social pressure for self-optimization and increasing social inequality [7]. Furthermore, as regards invasive technologies, it becomes relevant that enhancement implies moving away from a 'normal' body and thus initially leaving its target open [27, 49, 71]. The anthropological self-understanding is thereby irritated in the sense that enhancement potentially leads into the unknown and the transhuman becomes conceivable when technologies are permanently built into the body. Transhumanism interprets the modified body as a new species. The use of technology here represents the potential to overcome humanity [72].

As it turns out, technologies for therapy are much less controversial [6]. Therapy implies bringing 'deficient' bodies closer to a 'normal' body, which describes a concrete goal [49]. The interpretation as a therapy product thus has the potential effect of promoting acceptability, because body modifications here always imply a reproduction of the 'normal' body and familiar ideas about the human being. In societies in which the idea is established that individuals who deviate are expected to conform to the norm of the majority (medical model), therapy appears to be legitimate. The categorization as therapy thereby counteracts doubts regarding usefulness and a problematic harmfulness as well as influencing identity and the image of the human being. By referencing involvement in the medical system, Neuralink also suggests a strong external regulation of their product, thus attempting to increase trust in their product among the audience.

Finally, Neuralink contributes to the acceptability of the BCI by assigning technology to humans as a new body part in the description of the human-technology relationship. One potential crisis stems from the notion that technologies could control people, or that through technological interfaces people are no longer understood as closed entities but are controlled by other actors such as technology companies [59, 60]. In both cases, technology would lead to a loss of autonomy for the user. Contrary to these crises of a loss of autonomy, Neuralink presents its BCI as autonomy-enhancing body parts, firstly because humans are ascribed control over the technology rather than being controlled by it, and secondly because security is supposed to exist against external access to the BCI by other actors. If, in addition, the implant is seen as a „rescue measure" for humanity in

the face of artificial intelligence, a gain in autonomy for humanity is also stated on this second level. When the control via the smartphone app is highlighted as part of the description of the autonomy boost, this also implicitly responds to irritations regarding the simplicity of use.

On the Influence of Technology Development on Value Development

The case study shows the extent to which interpretations of a technology as a plausible future, as a therapy product, and as technology subordinated to humans can contribute to the promotion of acceptability. To evaluate the acceptability of technologies, it appears to be useful to reflect on these categorizations as explicitly promoting acceptability. Technologies should not be pre-categorized and discussed separately as therapeutic technologies and enhancement technologies. Instead, the acceptance-manipulating function of these framings should be critically examined.

If acceptability towards a technology depends in such a way on its interpretation, nearly any technology for bodies can be legitimized by the right presentation. Attitudes toward technologies do not result from the technologies themselves but from their categorization. It is not the technology that is more or less accepted but its interpretation. The results contribute to the understanding of the complicated dynamics between technological development and societal values.

Beyond that, the case study reveals which interpretations for invasive technology are currently considered legitimate. Acceptability is promoted by what supports humans without changing them. Contrary to the optimization maxims of the performance-oriented society, invasive technologies are not supposed to improve beyond established standards. Instead, on the one hand, new technologies are used to reproduce established norms. On the other hand, established norms are used to make changes to humans and society under their guise.

The example of BCIs also makes it clear that interpretations of technologies vary depending on their temporal embedding. What appears dehumanizing and undesirable in fiction can be „rehumanized" when it is brought close to the present. Modified bodies, positioned in science fiction as antagonists to the natural human body, are systematically placed within the spectrum of the human if they are to become reality.

At the same time, the analysis of the PR representation shows that complete unambiguity is not sought when framing new technologies. This is because PR communication must not only generate acceptability but also attention. Ambivalences, such as the oscillation between therapy and enhancement, are used to serve different communication goals. The official presentation as therapy is used to promote acceptability for the product, while unofficial offshoots of the presentation as enhancement draw attention to the product.

A Critical Evaluation of Neuralink'S BCI Representation

The framing of BCIs as an autonomy-enhancing therapeutic product for 'people with diseases' to promote acceptability was reconstructed under the premise of axiological neutrality. Even though this presentation serves an important function for Neuralink, it should be viewed critically.

Neuralink views 'deviant' bodies through the lens of the medical model. People with spinal cord injuries, the company's initial focus, are not categorized as people with disabilities but rather as people with a disease. Disabilities can be viewed from various perspectives. From the viewpoint of social and cultural models, people with disabilities are not considered in need of treatment; instead, these models emphasize that society must change to prevent further disadvantaging these individuals. In contrast, the medical model presents disability as an individual's problem, asserting that they are responsible for compensating for their 'deficits' and conforming to societal norms. Equating disability with illness suggests that it is in the interest of people with disabilities to rid themselves of their 'disease.' This also includes a techno-ableist assumption that glorifies technology as the only solution, often ignoring that people with disabilities can manage without technology and that technology leads to new dependencies and new discriminatory expectations [73].

Neuralink's adoption of the medical model perspective must be criticized in several respects. (1) The fact that they can promote acceptability for their BCI in this way indicates that ableist notions still dominate

in society. It remains normal to assign people with disabilities the responsibility for adjusting to societal norms, which reveals a broader societal issue. (2) By using the medical model perspective, Neuralink reproduces these views, which necessitates a critique of their PR representation. (3) One of the problems inherent in the ableist perspective is that it is still considered morally acceptable to conduct research on people with disabilities rather than on 'healthy' people. This is not only the case with BCIs but also with other technologies and medications that are initially developed for specific groups but can later be used for enhancement purposes. Research 'for' people with disabilities is sometimes even seen as heroic. The potential for harm to this group often seems to be weighed less heavily. This raises significant ethical concerns, even if the development of new technologies may eventually provide new benefits for these groups in the long term.

Beyond this general problem of using the medical model, there is a specific concern with Neuralink regarding whether this perspective is adopted merely out of a conservative alignment with current societal expectations or if it reflects an underlying political ideology. Elon Musk has increasingly downplayed or explicitly expressed right-wing political views in recent years. Against this backdrop, Neuralink's use of the ableist perspective appears not just conservative but also reminiscent of the eugenic belief that people with disabilities are of lesser value and a problem that needs to be solved. Furthermore, Neuralink's stated long-term goal of improving the lives of all people raises doubts about whether the company is genuinely focused on 'research or people with disabilities'.

Therefore, the question remains whether Elon Musk and Neuralink are simply exploiting the socially established acceptance of therapeutic products for legitimacy, as well as using people with disabilities as research subjects, to develop a product primarily aimed at human enhancement – if it will ever work at all.

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