BRAIN-COMPUTER INTERFACES AND BIOETHICAL IMPLICATIONS ON SOCIETY: FRIEND OR FOE?

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* *Juris Doctor Candidate*, May 2024, St. Thomas University Benjamin L. Crump College of Law. President, *Intellectual Property & Cyber Law Society*. This Comment is dedicated to my loving parents, Ian and Eleanor Landis, and my wonderful family for their unconditional love and support. I would also like to extend my heartfelt appreciation to my girlfriend, Brook, for her endless encouragement and understanding. I am grateful to my 1L legal writing professor, Wilfredo Fernandez, who became not only a mentor but also a cherished friend. I wish to acknowledge my intellectual property professors, Professor Zachary L. Catanzaro and Professor Ira S. Nathenson, for the invaluable knowledge I acquired during their courses throughout law school. Additionally, my sincere thanks go to the Honorable Judge Robert T. Watson for the opportunity to intern with him at the Eleventh Judicial Circuit of Florida. Lastly, my gratitude extends to the *St. Thomas Law Review* for preparing this publication.

I. INTRODUCTION

As a child in the 1990s, I was captivated by the rapid evolution of technology. I recall the days of recording my favorite TV show on a VCR and inserting a cassette into my Walkman to enjoy music. Today, recording a favorite show is as simple as clicking a button on a DVR or using remote voice control. Similarly, I can listen to any song with a few taps on my smartphone. This technological progress brings to mind the story of Frankenstein, in which a young scientist, Victor Frankenstein, becomes obsessed with creating life. He succeeds in creating a humanoid creature but, realizing the horror of his creation, abandons it. Mary Shelley's novel superbly exemplifies the moral and ethical dilemmas associated with technological advancements that are likely to occur in the coming decades. Do the benefits of novel creations outweigh the consequences, or is it the other way around? One of the ethical principles to consider is the balance between beneficence and non-maleficence, which is the obligation to do good and avoid causing harm.

With the growth in modern science comes advances to the field of neurotechnology, specifically brain-computer interfaces (BCIs). For example, one notable player in this field is Neuralink, a company founded by Elon Musk, which aims to develop advanced BCIs for various applications.[1] However, the misuse of implantable BCIs poses significant bioethical concerns related to privacy, autonomy, and potential abuse of power. Specifically, the rapid advancements in this field have prompted complex bioethical concerns, as scholars and practitioners wrestle with issues of autonomy, privacy, and potential misuse. It is crucial to thoroughly examine these concerns and implement regulations to protect individual rights. In this Comment, I will discuss the advantages and disadvantages of BCIs, their implications for bioethics, and the challenges of legal self-regulation that may arise in the future as BCI technology advances. Furthermore, I will address the perspectives of both advocates and critics of BCI technology to provide a comprehensive analysis of this emerging field.

A. BACKGROUND

The inception of BCI technology dates back to 1964 when Dr. Grey Walter first experimented by attaching electrodes to a patient's skull intraoperatively.[2] Next, he requested the patient to push a switch to control a projection device

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[1] *See* Elon Musk, *An Integrated Brain-Machine Interface Platform with Thousands of Channels*, 19 J. MED. INTERNET RES. 1, 11 (2019) (describing a novel system for recording and stimulating neural activity using flexible polymer probes, a robotic insertion system, and custom electronics).

[2] *See* DANIEL C. DENNETT, CONSCIOUSNESS EXPLAINED 167 (1991) (exploring consciousness and how it emerges from different events of content-fixation occurring in various places at different times).

while keeping track of their cognitive function by measuring their brainwaves.[3] Remarkably, Dr. Walter observed that the projector responded to the brain activity even before the button was pressed, signifying the first instance of manipulating an external device absent of any physical motion on the user's part.[4]

"[Coining the term for BCIs,] [i]n 1973, UCLA professor Jacques Vidal published 'Toward Direct Brain-Computer Communication' in the Annual Review of Biophysics and Bioengineering."[5] Over time, multiple researchers have crafted various devices that allow for converting thoughts into actions.[6] These innovative developments in neurotechnology comprise thought-driven robotic limbs, incorporating a robotic arm capable of transmitting sensory feedback to the brain and significantly advancing noninvasive control of mechanical equipment using BCIs.[7] Furthermore, several experts have delved into research methods for altering neural function, including approaches to manage epileptic seizures.[8] "In mid-2020, a team associated with the long-running BrainGate project announced that they had created a device that could translate the user's imagined handwriting movements into text in real time."[9] Additionally, the U.S. Food and Drug Administration (FDA) approved the Neurolutions Ipsi-Hand Upper Extremity Rehabilitation System in 2021.[10] This prescription-only system was specifically designed for those who have limited mobility, such as those who have suffered a stroke.[11] For the system to work, it captures the user's brain activity, thereby deciphering the intended muscle movements from the user and directing the device accordingly, allowing for the mobility of the individual's hand in the desired manner through their thoughts.[12]

By extension, FDA approval in 2021 was granted to a company called Synchron to conduct the first human trials of invasive BCI technologies by

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[3] *See id.*
[4] *See id.*
[5] Elle Rothermich, *Mind Games: How Robots Can Help Regulate Brain-Computer Interfaces*, 7 U. PA. J.L. & PUB. AFF. 391, 396-99 (2022) (quoting Jacques J. Vidal, *Toward Direct Brain-Computer Communication*, 2 ANN. REV. BIOPHYSICS & BIOENGINEERING 157, 157 (1973)).
[6] *See id.*
[7] *See* Bradley Jay Edelman et al., *Noninvasive Neuroimaging Enhances Continuous Neural Tracking for Robotic Device Control*, 4 SCI. ROBOTICS 1, 3 (2019) (describing a breakthrough in controlling robotic devices noninvasively through the use of brain-computer interfaces); *see also* Sharlene N. Flesher et al., *A Brain-Computer Interface That Evokes Tactile Sensations Improves Robotic Arm Control*, 372 SCI. 831 (2021) (reporting on a robotic arm that provides tactile feedback directly to the brain).
[8] *See* Rothermich, *supra* note 5, at 396.
[9] *Id.*
[10] *See id.*; *see also* FDA, *FDA Authorizes Marketing of Device to Facilitate Muscle Rehabilitation in Stroke Patients* (Apr. 23, 2021), https://www.fda.gov/news-events/press-announcements/fda-authorizes-marketing-device-facilitate-muscle-rehabilitation-stroke-patients (describing FDA-authorized IpsiHand System device to aid stroke rehabilitation through brain-controlled electronic brace).
[11] *See* Rothermich, *supra* note 5, at 396.
[12] *See id.* at 397.

implanting a catheter-directed sensor into the brain via blood vessels.[13] The company aims to open the brain's natural communication pathways by using a neuro-endovascular implant that can transfer information from every quadrant of the brain.[14] Conversely, Elon Musk's Neuralink has been denied permission to conduct BCI human trials by the FDA due to concerns related to the safety of the device.[15] The company has refused to release the FDA's rejection documents but has disclosed that the primary concerns involved the potential of tiny wires, which constitute part of the BCI, to migrate to other areas of the brain, and the lack of specificity regarding the medical procedures to remove the device without damaging the brain tissue.[16] However, in May 2023, Neuralink announced that the FDA had green-lighted their first-in-human clinical trial and lauded the approval as a pivotal initial step towards its goal of creating technology with widespread benefits.[17] In January 2024, Elon Musk announced on X (formerly Twitter) that the first recipient of a Neuralink implant was recovering well, and early findings showed promising detection of neuron spikes.[18]

BCIs are devices that allow the exchange of messages without physical movement, enabling individuals to interact solely through their thoughts.[19] These interface systems are especially useful for people with severe neurological disabilities who cannot use conventional communication methods such as speaking or operating a computer.[20] While most BCI studies have centered around helping severely disabled individuals gain a greater sense of autonomy, the neurotechnological field is gradually broadening.[21] For example, the introduction of the development of BCI-based game applications to be played by

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[13] *See* SYNCHRON, *About Us*, https://synchron.com/about-us (last visited April 15, 2024) (implementing a minimally invasive procedure to prevent the need for open brain surgery).

[14] *See id.*

[15] *See* Rachael Levy & Marisa Taylor, *Brain Teaser*, REUTERS (Mar. 2, 2023), https://www.reuters.com/investigates/special-report/neuralink-musk-fda (detailing the FDA's refusal to approve Neuralink's request for human trials due to unresolved safety concerns).

[16] *See id.*

[17] *See* Neuralink (@neuralink), TWITTER, (May 25, 2023, 6:10 PM), https://twitter.com/neuralink/status/1661857379460468736 (announcing FDA's approval for Neuralink's initial human clinical study and indicating forthcoming recruitment for future participants).

[18] *See* Elon Musk (@elonmusk), TWITTER, (Jan. 29, 2024, 5:37 PM), https://twitter.com/elonmusk/status/1752098683024220632 (reporting the implantation of Neuralink's device in the first human recipient).

[19] *See* Kevin M. Pitt & Jonathan S. Brumberg, *Guidelines for Feature Matching Assessment of Brain-Computer Interfaces for Augmentative and Alternative Communication*, 27 AM. J. SPEECH-LANGUAGE PATHOLOGY 950, 950 (2018) (introducing a procedure to optimize the selection of BCIs for users, enhancing the effectiveness of augmentative and alternative communication devices).

[20] *See* Institute of Neural Engineering, Graz University of Technology, *Basics*, BNCI HORIZON 2020, http://bnci-horizon-2020.eu/index.php/about/basics (last visited April 15, 2024) (analyzing BCIs as devices that enable communication through thought alone, highlighting their potential for severely disabled users and how they have evolved into hybrid and multimodal BCIs).

[21] *See id.* ("Most BCI research focuses on helping severely disabled users send messages or commands. However, this is beginning to change.").

non-disabled users, and various stakeholders are exploring new gameplay applications and user demographics for BCIs.[22]

Consequently, numerous misconceptions exist regarding the capabilities and limitations of this technology.[23] It is essential to understand that BCIs do not modify or alter the brain, change the perceptions of an individual, or implant words and thoughts into the user's mind to carry out a particular task trying to be performed.[24] Additionally, BCIs cannot function remotely or without the user's awareness of what is going on.[25] To effectively operate a BCI, an individual wears a device on their head and consciously engages in particular mental exercises to achieve their objectives and underlying goals.[26]

In the most adopted definition, any BCI must meet four criteria. First, the BCI must directly measure brain activity. Second, it should provide feedback to the user. Third, the BCI must function in real-time or online. Fourth, it must depend on the user's intentional control, meaning that users consciously perform a mental task to send a message or command each time they wish to use the BCI.[27] In other words, a BCI functions by accurately interpreting the user's intentional brain activity in real time, empowering them to communicate or execute commands through conscious mental effort. "A more recent definition describes a BCI as . . . '[A] system that measures central nervous system (CNS) activity and converts it into artificial output that replaces, restores, enhances, supplements, or improves natural CNS output and thereby changes the ongoing interactions between the CNS and its external or internal environment.'"[28]

Additionally, "BCI systems have . . . [a range of uses, including] neurorehabilitation, assistive device technology, cognitive enhancement, and human-to-computer communication."[29] These devices are further employed to facilitate

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[22] *See id. See generally* Man Li et al., *The MindGomoku: An Online P300 BCI Game Based on Bayesian Deep Learning*, 21 SENSORS 1613 (2021) (introducing MindGomoku, a BCI game that showcases the potential of BCI technology for entertainment and aiding disabled users, employing a Bayesian deep learning approach for improved control and reduced fatigue, evidenced by high accuracy and user engagement).

[23] *See* Graz University of Technology, *supra* note 20 (addressing the public misconceptions regarding BCI technology).

[24] *See id.* ("BCIs do not write to the brain. BCIs do not alter perception or implant thoughts or images.").

[25] *See id.* ("BCIs cannot work from a distance, or without your knowledge.").

[26] *Id.* ("To use a BCI, you must have a sensor of some kind on your head, and you must voluntarily choose to perform certain mental tasks to accomplish goals.").

[27] *Id.* (quoting Gert Pfurtscheller et al., *The Hybrid BCI*, 4 FRONT. NEUROSCI. 1, 2 (2010)).

[28] *Id.* (quoting JONATHAN R. WOLPAW & ELIZABETH W. WOLPAW, BRAIN–COMPUTER INTERFACES: PRINCIPLES AND PRAC. 3-12 (2012)).

[29] *Brain-Computer Interface*, GOLDEN, https://golden.com/wiki/Brain-computer_interface-MNNNZ53 (last visited April 15, 2024); *see also* Simanto Saha et al., *Progress in Brain Computer Interface: Challenges and Opportunities*, 15 FRONT. SYST. NEUROSCI. 1, 1–2 (2021) (reviewing advancements in BCI technology addressing the significant strides and the challenges faced in enhancing BCI applications in overcoming technological and psychophysiological barriers to fully integrate BCIs into daily life).

"communication or control of external prosthetic devices in people living with conditions such as spinal cord injury, amyotrophic lateral sclerosis (ALS), locked-in syndrome (LIS), and multiple sclerosis (MS)."[30] For that reason, continued advancements in this field offer extraordinary possibilities for individuals suffering from neurological and neuropsychiatric disorders.[31] Inner Cosmos, a BCI startup, has claimed that its brain-computer interface could be installed during the medical procedure by removing a layer as minuscule as a millimeter from the skull's surface.[32] Meron Gribetz, Inner Cosmos' chief executive officer, stated that the technology has advanced enough to the point where it can address conditions, such as depression, that have proven resistant to conventional treatments.[33] Accordingly, the rapid progress in BCI technology has raised significant ethical concerns.[34] Scholars and practitioners are grappling with questions of autonomy, privacy, and potential misuse of the technology, with ethicists presenting arguments for and against its widespread adoption.[35]

Similarly, taking into account the commercial development of neurodevices for neuroimaging, and neurostimulation with their increasing availability to consumers for extra-clinical purposes, such as entertainment (e.g., gaming), wellness, and enhancement (e.g., augmentation of attention abilities), neurotechnology will progressively be used to assist people in daily activities and enhance their quality of life.[36] However, as promising as neurotechnology may be, it is also a technology that interferes with the "last refuge of personal freedom and self-determination" and gives rise to a variety of severe ethical concerns.[37] It is, therefore, of critical importance that neurotechnological

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[30] *See Brain-Computer Interface*, *supra* note 29 (referencing Reza Abiri et al., *A Comprehensive Review of EEG-Based Brain–computer Interface Paradigms*, 16 J. NEURAL ENG'G 1, 13 (2019)).

[31] *See* Reza Abiri et al., *A Comprehensive Review of EEG-Based Brain–computer Interface Paradigms*, 16 J. NEURAL ENGINEERING 1, 13 (2019) (providing an evaluation of EEG-based BCI paradigms, detailing advancements, challenges, the potential for neurorehabilitation, and future directions for BCI research).

[32] *See* Sarah McBride, *Brain-Computer Startup Aims to Treat Depression Without Opening a Skull*, BLOOMBERG (Mar. 30, 2022), https://www.bloomberg.com/news/articles/2022-03-30/inner-cosmos-makes-bci-to-rival-neuralink-elon-musk (detailing the development of a non-invasive BCI aimed at treating depression by sending electrical currents into the brain, avoiding the need for deep cranial surgery).

[33] *See id*.

[34] *See* Rafael Yuste et al., *Four Ethical Priorities for Neurotechnologies and AI*, 551 NATURE 159, 159 (2017) (emphasizing the need for ethical guidelines in developing neurotech and AI to preserve privacy, identity, agency, and equality and proposing steps to address these concerns of rapidly advancing technologies).

[35] *See id*. at 159–161.

[36] *See* Iris Coates McCall et al., *Owning Ethical Innovation: Claims About Commercial Wearable Brain Technologies*, 102 NEURON 728, 728 (2019) (critiquing direct-to-consumer neurotechnology against the backdrop of scientific evidence, highlighting the ethical implications for consumer wellness, enhancement, and health).

[37] *See* Marcello Ienca & Roberto Andorno, *Towards New Human Rights in the Age of Neuroscience and Neurotechnology*, 13 LIFE SCI. SOC'Y & POL'Y 1, 1 (2017) (addressing the establishment of

developments proceed within an ethical and legal framework which takes these concerns into account. "Such a framework needs proactive and thorough reflection in order to see if any regulatory action is required."[38]

Neuralink, founded in 2016 by Elon Musk, has been at the forefront of BCI development and aims to create advanced BCIs to enable seamless interaction between humans and artificial intelligence.[39] The company's vision includes applications in healthcare, cognitive enhancement, and communication.[40] Neuralink has developed a high-bandwidth BCI, which involves implanting a device called the "Link" in the brain to record and stimulate neural activity.[41] While the company's work is still in its early stages, it has drawn significant attention and raised important bioethical questions.[42]

The ethical apprehensions discussed here relate to the influence of neurotechnologies on the human psyche.[43] Undoubtedly, these neurotechnologies, especially when involving surgical implantation, can pose notable risks to a person's bodily integrity.[44] Despite being rooted in critical principles like doing good, avoiding harm, personal decision-making freedom, and fairness in healthcare, the existing bioethical guidelines adequately assess the expected advantages and physical dangers of invasive neurological procedures.[45] Nonetheless, these guidelines do not cover emerging risks from technological medical advancements that might be harmful to the brains of individuals.[46] Consequently, because of this oversight, neuroethics brings issues around bias, confidentiality, genuineness, selfhood, and self-governance to the forefront.[47]

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new human rights to protect individuals from potential abuses and ensure the ethical use of advancements in neuroscience and neurotechnology, specifically addressing cognitive liberty, mental privacy, mental integrity, and psychological continuity).

[38] Timo Istace, *Neurorights: The Debate About New Legal Safeguards to Protect the Mind*, 37 ISSUES L. & MED. 95, 101 (2022) (exploring the necessity for neurorights within the domain of human rights law to offer legal protection).

[39] *See* John Markoff, *Elon Musk's Neuralink Wants 'Sewing Machine-Like' Robots to Wire Brains to the Internet,* N.Y. TIMES (July 16, 2019), https://www.nytimes.com/2019/07/16/technology/neuralink-elon-musk.html (discussing Elon Musk's aspirations to create consumer-focused neural interfaces enabling communication between the human brain and computers).

[40] *See* Musk, *supra* note 1, at 11.

[41] *See id.* at 1.

[42] *See generally* Abhinav Kulshreshth et al., *Neuralink- an Elon Musk Start-Up Achieve Symbiosis with Artificial Intelligence*, INT'L CONF. ON COMPUTING COMM. & INTELLIGENT SYS.S (2019) 1, 1–5 (highlighting the ethical considerations related to technologies like the ones proposed by Neuralink).

[43] *See* Istace, *supra* note 38, at 101.

[44] *See* Yuste et al., *supra* note 34, at 162.

[45] *See* Istace, *supra* note 38, at 101.

[46] *See id.*

[47] *See id.*

II. BCI TECHNOLOGY AND APPLICATIONS

BCIs can be categorized into three primary categories: Invasive, partially invasive, and non-invasive.[48] "Invasive BCIs [involve surgically implanting] . . . electrode arrays that sit in the brain. They can 'read' the activity of a small group of neurons or even a single neuron. This requires delicate, invasive surgery to place the electrodes near the target neurons[,]" typically yielding better results than non-invasive alternatives.[49] This is the concept behind Neuralink. Partially invasive BCIs, which employ ECoGs, involve implanting electrodes in the skull or on the brain's surface, serving as a compromise between internal and external BCIs in terms of signal quality.[50] To illustrate, Synchron, as expressed above would fall under this category. Lastly, non-invasive BCIs, particularly electroencephalography (EEG) and functional magnetic resonance imaging (fMRI), do not require any surgical intervention and use devices which do not require to pass through the cranium.[51] "These BCIs 'read' the activity of a large group of neurons[,]" though with less accuracy compared to invasive methods.[52] In essence, these varying levels of BCI invasiveness offer a range of options that cater to diverse applications and patient needs, shaping the future of human-computer interaction and neurotechnology.

III. AUTONOMY

"The notion of autonomy 'is generally understood to refer to the capacity to be one's person, to live one's life according to reasons and motives that are taken as one's own and not as the product of manipulative or distorting external forces.'"[53] Self-directed individuals have the capacity to decide and act based on their own goals and preferences without being swayed by external forces.[54] This autonomy includes the liberty to embrace personal beliefs and weigh the merits and drawbacks of particular choices one may make.[55] Autonomy's essential facet also involves careful contemplation, enabling individuals to contemplate societal standards and intrinsic values while choosing which ones to consider or discern.[56] These autonomy characteristics signify the importance

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48 *See* Rothermich, *supra* note 5, at 398–99.
49 *Id.* at 399.
50 *See id.*
51 *See id.*
52 *See id*.
53 Andrea Lavazza, *Free Will and Autonomy in the Age of Neurotechnologies*, *in* PROTECTING THE MIND 2020, at 42 (Pablo López-Silva & Luca Valera eds., Ethics of Sci. and Tech. Assessment Ser. No. 49, 2022) (quoting John Christman, *Autonomy in Moral and Political Philosophy*, STAN. ENCYC. OF PHIL., https://plato.stanford.edu/entries/autonomy-moral (last modified June 29, 2020)).
54 *See id.* at 44.
55 *See id.* at 43.
56 *See id.*

of analytical thought in shaping a person's alignment with the principles, goals, and innate traits they have come to adopt.[57]

One of the main bioethical concerns associated with BCIs is the potential impact on autonomy, or the ability to make decisions about one's own life.[58] Invasive BCIs, which require surgery to implant electrodes directly into the brain, raise particular concerns about the potential impact on autonomy.[59] Advocates of BCIs argue that they can actually enhance autonomy by providing individuals with new means of communication and a greater sense of control over their surroundings.[60] For instance, such BCI technologies can address various limitations, whether inborn or stemming from medical conditions or trauma experienced in one's lifetime.[61] Further, they also empower individuals to fulfill their aspirations better when focused on enhancing their physical or cognitive abilities.[62] To illustrate, individuals with severe motor impairment may gain greater autonomy by using BCIs to control assistive technologies, which they otherwise would not have been able to do in certain situations, such as communicating with another. Effective communication is fundamental to autonomy enabling individuals to express themselves, promoting a deeper understanding of their unique perspectives, and facilitating informed decision-making in their daily lives.

In the alternative, critics argue that the use of invasive BCIs to enhance cognitive abilities or control neuroprosthetic devices may lead to a loss of autonomy if the technology becomes too integrated into an individual's self-image.[63] Individuals who have used these BCI devices report experiencing changes in their sense of self and feeling less connected to their own identity, particularly if they were struggling with low self-esteem.[64] For example, in a 2017 study, six patients with artificially intelligent BCI implants were examined for self-change perceptions, providing critical insights for ethical guidelines on clinical BCI protocols; notably, Patient 3 experienced self-image issues.[65] It was expressed by Patient 3 that the BCI rendered them powerless.[66] The primary recommendation of the study is to promote further research to understand BCIs' long-term effects on patients' identity and inform patients of transient deteriorative effects.[67] The second recommendation is to cautiously approach

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[57] *See id.*
[58] *See id.* at 44.
[59] *See* Lavazza, *supra* note 53, at 45.
[60] *See id*. at 49.
[61] *See id*.
[62] *See id*.
[63] *See id*.
[64] *See* Frederic Gilbert et al., *Embodiment and Estrangement: Results from a First-In-Human "Intelligent BCI" Trial*, 28 SCI. & ENG'G ETHICS 83, 83 (2019).
[65] *See id*. at 91.
[66] *See id.* at 88.
[67] *See id.* at 91.

BCI implantation in patients with preoperative self-image concerns until potential negative effects are better understood.[68] Cases where BCIs significantly impact self-perception may be linked to critical identity development periods, potentially leading to autonomy infringement through control exertion.[69] As a result, BCIs could potentially be used to exert control over individuals, infringing on their autonomy.

This Comment raises the question of whether we are trying to move toward a world without disability and whether reducing physical disability by itself is wrong. Patients with these disorders and their families are incredibly frustrated that we do not have suitable treatments for all severe neurological and physical injuries and diseases today. As such, we, as a society, are desperate to develop them. These patients and their families are looking for solutions and answers. Improving our mental capacities and integrating our minds with digital technologies can heighten our sense of freedom and self-determination by presenting us with a more diverse array of opportunities.[70] With this in mind, this shift would allow us more significant influence over our actions and expand the spectrum of possibilities available to us on both functional and intellectual levels.[71] As a result, the developed technologies may soon become more powerful and flexible, increasing the availability of restorative neurotechnologies. It is an optimistic approach that somebody can use the BCI technology for the greater good to help restore autonomy in those individuals who choose to receive such treatment by giving proper informed consent.

IV. PRIVACY

Another bioethical concern associated with BCIs is the potential impact on privacy. Invasive BCIs raise concerns about the potential for unauthorized access to an individual's thoughts and emotions.[72] However, ethicists contend that despite advancements in neurotechnologies, concerns over mental privacy may be overstated due to significant limitations in current "mind-reading" capabilities.[73] To illustrate, a significant worry about the confidentiality of our internal thoughts is the ability of BCIs to access and interpret various private mental activities, encompassing the imagination of a serene beach, empathizing with a friend's distress, reliving a cherished childhood moment, or even contemplating a future goal.[74] Such capabilities raise profound questions about the boundaries

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[68] *See id.*
[69] *See id.*
[70] *See* Lavazza, *supra* note 53, at 49.
[71] *See id.* at 50.
[72] *See* Abel Wajnerman & Pablo López-Silva, *Mental Privacy and Neuroprotection: An Open Debate*, *in* PROTECTING THE MIND 2020, at 145 (Pablo López-Silva & Luca Valera eds., Ethics of Sci. and Tech. Assessment Ser. No. 49, 2022).
[73] *See id.*
[74] *See id.*

and security of personal mental space. However, several studies focused on deciphering thoughts often employ a "constrained selection approach," where the user and the analytical tool must choose from a fixed range of possibilities.[75] As a result, the ability to decipher thoughts remains restricted to these preset choices.[76] "We can call this, an ecological-based skepticism about mental privacy . . . that the methods used to claim that neurotechnological devices can 'read minds' are way too far from real-life situations in terms of setting and scope."[77]

Alternatively, in a hypothetical scenario, critics argue that the potential for unauthorized access to an individual's thoughts and emotions raises serious privacy concerns that must be addressed.[78] For example, BCIs pose significant risks to privacy, as they could potentially be used to access individuals' thoughts or manipulate their behavior.[79] Some ethicists argue that these concerns are too great and that the technology should be strictly regulated or even banned to protect individual rights.[80]

Given individuals' use of technology, a vast amount of private data can already be gathered from the digital footprints that individuals leave behind in today's interconnected world.[81] People often find themselves constantly attached to their smartphones, which have become integral to their daily lives and interactions with others, whether personally or professionally. By extension, a 2015 study conducted by MIT researchers highlighted that examining the inputs of smartphone typing usage on users' behaviors might contribute to the early identification of Parkinson's disease.[82] "A 2017 study suggests that measures of mobility patterns . . . from people carrying smartphones during their normal daily activities, can be used to diagnose early signs of cognitive impairment resulting from Alzheimer's disease."[83] On that basis, incorporating neural activity patterns corresponding to specific attention states through these computational neural algorithms could significantly improve the effectiveness of targeting individuals that cater to their particular needs and open the door to unwanted intrusions from a third party accessing one's private sensitive information.[84] Accordingly, there needs to be a delicate balance between embracing

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[75] *See id.*
[76] *See id.*
[77] *Id.*
[78] *See generally* Yuste et al., *supra* note 34, at 160 (noting that technology is leading to unauthorized access to an individual's thoughts and emotions via BCIs necessitates stringent safeguards).
[79] *See id.* at 161.
[80] *See* Ienca & Andorno, *supra* note 37, at 2 (noting that the privacy risks posed by BCIs may lead to the "creation of new rights to protect people from potential harm").
[81] *See* Yuste et al., *supra* note 34, at 161 (emphasizing that large amounts of people's private information can be obtained via their data trail).
[82] *See id.*
[83] *Id.*
[84] *See id.*

innovation and safeguarding the personal privacy of the users, ensuring that the benefits of these breakthroughs are harnessed without compromising individual security and implicating effects on one's autonomy.

While present-day technology has not yet been mastered and cannot readily decode and interpret electrical impulses gathered by these devices, attempts are directed toward using artificial intelligence to decipher the captured data.[85] Based on these technological limitations, some ethicists have pointed out that privacy concerns may not be a pressing issue right now, particularly when considering the misconception that BCIs can read minds out of context. However, these measures/impulses extracted also involve viable images from neural signals.[86] If unauthorized third parties capture these signals, they could pose privacy risks for the person who produced them.[87] In addition, cybercriminals or companies might utilize this information to infer an individual's mental capacity and character attributes.[88] To illustrate, BCI data can also shed light on an individual's wellness, mental function, and emotional well-being.[89] Moreover, government agencies could potentially use this data to access information otherwise protected by biometric technologies.[90] Furthermore, the data could reveal insights into a person's thinking patterns, which might be exploited to their disadvantage if misused by these entities retaining this personal data.[91]

Elon Musk's Neuralink device is designed to be both accessible and beneficial from a medical standpoint.[92] This innovative BCI stands out from existing technologies as it features the potential of connecting thousands of neurons through an implanted chip.[93] "The device is supposed to incorporate both a standard USB interface . . . [and] wireless (Bluetooth) capabilities."[94] However, considering the device's high public profile, and the potential, yet uncertain, consequences of it being hacked, Neuralink may become an appealing target for cybercriminals.[95] Such cyberattacks could result in actual harm to the users of the device, such as causing unintended neural activation or triggering negative

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[85] *See* Dov Greenbaum, *Cyberbiosecurity: An Emerging Field That Has Ethical Implications for Clinical Neuroscience*, 30 CAMBRIDGE Q. HEALTHCARE ETHICS 662, 664 (2021) (explaining that cyberbiosecurity poses ethical concerns in clinical neuroscience, including privacy risks and the need to protect against unauthorized data access).
[86] *See id.* at 664 (noting the concerns of current efforts to use artificial intelligence to decode information and extract images from brain signals).
[87] *See id.*
[88] *See id.*
[89] *See id.*
[90] *See id.*
[91] *See* Greenbaum, *supra* note 85, at 664.
[92] *See id.* at 665 (noting that Elon Musk's Neuralink is designed to be "user friendly" and "medically relevant").
[93] *See id.*
[94] *Id.*
[95] *See id.*

reactions in the brain.[96] Here, this actual harm implicates the principle of non-maleficence: to not harm.

By extension, the risk of cyberattacks on Neuralink is heightened due to its intended compatibility with smartphones, third-party apps, and potential cloud data storage.[97] "A relatively novel ethical concern with Neuralink compared to other [BCI] devices in clinical neuroscience is the degree to which the device will be communicating with the internet and the consent that such communication will demand."[98] Since Neuralink would be constantly connected to a person's brain, it is crucial to safeguard and maintain its security through regular software updates.[99] These updates might have to be executed without obtaining the user's permission, considering the necessity of maintaining safety and the potential for certain users to be incapable, reluctant, or uninterested in applying the updates independently.[100] This situation is reminiscent of the hesitance many people exhibit when it comes to updating the security of their personal devices, like smartphones and computers, which can leave them exposed to potential cyber risks. In addition, these updates often require users to accept terms and conditions before they can be applied. This can be another hurdle for some individuals who may wish to refrain from agreeing to such updates. By extension, the lack of consent raises ethical questions, further emphasizing the need to carefully consider the balance between user autonomy and the device's security requirements. Additionally, the lack of consent also raises the bioethical principle of truth-telling, which allows the disclosing of info needed for the patient to make an informed choice if receiving the BCI.

Moreover, a 2018 analysis by the United Nations (UN) Special Rapporteur highlighted the privacy concerns related to AI, which examined the BCI technology's impact on human rights.[101] A key issue identified in the report is the potential loss of human oversight.[102] Although humans presently control AI, there are concerns that future advancements may lead to humans losing control over the technology, resulting in AI governing human actions instead.[103] This shift could pose risks to transparency and accountability, further emphasizing the need to address privacy and ethical considerations as AI evolves.[104]

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[96] *See id.*
[97] *See* Greenbaum, *supra* note 85, at 665.
[98] *Id.* (explaining the ethical concerns with Neuralink's communication with the internet and users' consent to such interaction).
[99] *See id.*
[100] *See id.*
[101] *See* Lydia Montalbano, *Brain-Machine Interfaces and Ethics: A Transition from Wearable to Implantable*, 16 J. BUS. & TECH. L. 191, 209 (2021) (examining the ethical considerations of advancing from wearable to implantable brain-machine interfaces).
[102] *See id.*
[103] *See id.*
[104] *See id.*

As a result, the advancement of AI is evident in the development of applications like ChatGPT and other AI software, which are increasingly demonstrating autonomous capabilities.[105] In response to these advancements, some experts have called for caution and consideration of ethical implications in AI development.[106] One notable example is an open letter from the Future of Life Institute, endorsed by numerous AI researchers and leaders, including Elon Musk and Steve Wozniak, co-founder of Apple.[107] The letter urges that research should focus on making AI beneficial to society and ensuring its safety.[108] This emphasis on safety and ethics raises specific privacy concerns, especially if AI applications become more prevalent in future BCI innovations. Ensuring a balance between the benefits of AI and the protection of user privacy will be crucial as these technologies continue to evolve.

Furthermore, the AI involved in BCIs has the potential to influence freedom of expression and opinion.[109] To illustrate, BCIs could be utilized to promote and suggest provocative material with the intent of keeping users hooked on the web and attached to their services.[110] Digital platforms whose revenue streams hinge on maintaining the individual's attention through marketing and monetization strategies might exploit this capability by promoting misinformation, encouraging echo chambers, or contributing to addiction-like behavior in the users, thus raising significant bioethical concerns.[111] Here, manipulating user engagement through provocative content could compromise users' ability to form and express their opinions, undermining their autonomy. Also, exploiting BCIs to promote controversial content for user engagement may lead to the dissemination of misinformation or the polarization of public discourse, connecting to non-maleficence to minimize the potential harm.[112] In addition, using BCIs to manipulate user engagement online is contrary to virtues such as honesty, transparency, and fairness, thus implicating the ethical theory of virtue bioethics.[113]

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[105] *See* Cade Metz & Gregory Schmidt, *Elon Musk and Others Call for Pause on A.I., Citing 'Profound Risks to Society*, N.Y. TIMES (Mar. 29, 2023), https://www.nytimes.com/2023/03/29/technology/ai-artificial-intelligence-musk-risks.html (highlights the call for regulatory AI oversight to manage these risks effectively).
[106] *See id.*
[107] *See id.*
[108] *See id.*
[109] *See* Montalbano, *supra* note 101, at 209 (noting that artificial intelligence can have negative impacts on the basic principles of freedom of expression and opinion).
[110] *See id.*
[111] *See id.*
[112] *See generally* Paul M. Barrett et al., *Fueling the Fire: How Social Media Intensifies U.S. Political Polarization—and What Can Be Done About It*, 2021 NYU STERN CTR. FOR BUS. & HUM. RTS. 1, 4-6 (analyzing the role of social media in exacerbating political polarization in the United States and offering recommendations for governmental and industry actions to mitigate the issue).
[113] *See* Rosalind Hursthouse & Glen Pettigrove, *Virtue Ethics*, STAN. ENCYC. OF PHIL, https://plato.stanford.edu/entries/ethics-virtue (last modified Oct. 11, 2022) (explaining in moral philosophy, virtue ethics prioritizes moral character over rules or consequences).

V. CHALLENGES, LEGAL IMPLICATIONS, AND POSSIBLE SOLUTIONS

While the ecological and priority arguments against mental privacy contribute to the debate, they do not provide sufficient grounds to dismiss concerns about protecting access to our neural information, considering current BCI developments.[114] Ecological constraints may be overcome, and priority concerns can be addressed through parallel work.[115] Consequently, there are no strong arguments for disregarding the significance of this discussion.[116]

Conversely, as we acknowledge the possible presence and hazards of mind-reading through neurotechnology and its implications for mental privacy, a crucial inquiry arises: Is there a need for new legal frameworks to regulate such activities?[117] Unauthorized acquisition of an individual's neural information might lead to dire consequences such as discrimination in the job market, personalized advertising based on intimate inclinations, or even manipulation by political groups.[118] "[S]ome have argued that current legislation related to informational privacy . . . [such as] the 'reasonable expectation of privacy' safeguarded by the Fourth Amendment to the U.S. Constitution, may constitute sufficient protection."[119] The argument is twofold: First, collecting mental information from neurological data might not be significantly different from the common practice of interpreting others' thoughts and emotions based on their actions.[120] This suggests that there may not be any further privacy concerns beyond those typically encountered in our normal day-to-day correspondence with others.[121] Second, it has been suggested that the dangers associated with gathering neural data are comparable to those linked to collecting other kinds of personal information.[122] For example, in *United States v. Jones*, the Supreme Court held that the long-term tracking of a person's movements using a GPS device constitutes a search under the Fourth Amendment.[123] This decision could serve as a basis for extending the same protections to neural data collection, as the risks associated with tracking neural information might be similar to those related to monitoring a user's movements. In such a scenario, the current

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[114] *See* Wajnerman & López-Silva, *supra* note 72, at 146 (addressing the concerns of protecting neural information in light of advanced neurotechnological developments).
[115] *See id.*
[116] *See id.*
[117] *See id.*
[118] *See id.*
[119] *Id.* (highlighting the legal protection of neural data as personal information to safeguard mental privacy (citing Abel Wajnerman Paz, *Is Your Neural Data Part of Your Mind? Exploring the Conceptual Basis of Mental Privacy*, 32 MINDS & MACHINES 395, 398 (2022))).
[120] *See* Wajnerman & López-Silva, *supra* note 72, at 146 (noting the rising privacy concerns due to the advancement of neurotechnological developments).
[121] *See id.*
[122] *See id.*
[123] *See* United States v. Jones, 565 U.S. 400, 404 (2012) (holding that the installation of a GPS device on a person's vehicle and its use of monitoring that person constitutes a search).

protection of informational privacy might be adequate to defend neural data without necessitating the creation of new legal provisions.[124]

Additionally, it is possible that at this stage, neurological data may not require special protection compared to blood, saliva, or urine.[125] The Fourth Amendment governs the standard for state seizure or searches of physical products, considering an individual's reasonable expectation of privacy balanced against the state's needs.[126] This flexible test might offer less protection than many people assume. Jurisprudence has emphasized the degree of physical imposition by the state on a person rather than the extent of informational imposition or intrusion on autonomy and dignity.[127] As a result, there is more protection against invasive procedures, such as blood tests, than there would be for non-invasive devices that detect neurological signals.[128] Here, the current legal framework prioritizes concerns regarding physical invasiveness and risk while providing little clarity and protection for the informational self, which is more representative of our true identity. To ensure comprehensive and clear safeguards for individuals using BCIs, it is crucial to establish legislation and regulation proactively instead of relying on the courts to address these issues incrementally through case-by-case decisions. This approach can prevent significant delays from waiting for court rulings, allowing for more timely and effective user privacy and autonomy protection.

In the alternative, neural data in relation to invasive BCIs presents a unique intersection of physical and informational impositions, as it can be used to infer a person's thoughts or physical state based on their brain activity.[129] This challenges existing categories and raises new questions about privacy in BCIs, such as the potential emergence of commercial surveillance capitalism, where corporations could exploit neural data for profit-driven motives. The *Kyllo v. U.S.* case, which dealt with remote surveillance, may provide some guidance for future BCI privacy arguments.[130] In *Kyllo*, Justice Scalia, writing for the Court,

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[124] *See* Wajnerman & López-Silva, *supra* note 72, at 146.

[125] *See* Skinner v. Ry. Labor Executives' Ass'n, 489 U.S. 602, 615–18 (1989) (involving a urine test); *see also* Schmerber v. California, 384 U.S. 757, 766–72 (1966) (pertaining to a blood test).

[126] *See* U.S. CONST. amend. IV. (giving people the right to be protected by unreasonable searches and seizures by the government).

[127] *See* Katz v. United States, 389 U.S. 347, 361 (1967) (Harlan, J., concurring) (explaining a two-part test for a person's reasonable expectation of privacy, which remains central to Fourth Amendment jurisprudence, requiring the individual to demonstrate a subjective expectation of privacy that society also deems reasonable); *see also* Smith v. Maryland, 442 U.S. 735, 739 (1979) (stating that Katz continues to serve as the "lodestar" of the Fourth Amendment privacy legal precedents).

[128] *See* Francis Shen, *Privacy, Security, and Human Dignity in the Digital Age: Neuroscience, Mental Privacy, and the Law*, 36 HARV. J.L. & PUB. POL'Y 653, 699 (2013) ("If one has a reasonable expectation of privacy in one's blood and urine, surely one has a reasonable expectation of privacy in one's brain cells.").

[129] *See id.* at 706.

[130] *See id*. at 130; *see also Kyllo*, 533 U.S. at 27 (holding that when the government uses a device not used by the general public to explore private details of a home, this surveillance constitutes a search).

stated that using thermal imaging cameras to look into a home was partly prohibited because it involved an unusual technology that violated the expectation of privacy in one's home.[131] Consequently, protection was granted against this technology.[132] Applying this reasoning to BCIs, one could argue that as these devices become more advanced and capable of detecting detailed neural information, privacy protections should be put in place to safeguard individuals against unwanted intrusions.

Furthermore, protecting an individual's inner monologue is essential as it forms the core of one's identity, beliefs, and thought processes. This private mental space allows for the development of individual creativity, introspection, and the capacity to make decisions without external influence. For instance, protecting a person's inner dialogue ensures that their most intimate thoughts and ideas remain their own, safeguarding intellectual property, artistic expression, and personal secrets. However, it is essential to recognize that technological innovation often relies on capital investment, which can come with its concerns. For example, suppose the development and control of BCI technology falls primarily into the hands of the government or a few powerful entities. In that case, there is a risk of potential misuse and infringement on individual privacy.

As a result, not sharing neural data from BCI device users should be the default choice option and should be carefully safeguarded.[133] Often, individuals willingly relinquish their right to privacy to companies providing services that the user seeks to use—such as online shopping, video streaming platforms such as TikTok, or messaging apps—without fully understanding the consequences.[134] In many countries, opting out would result in neural data being treated similarly to organs and tissues.[135] To share neural data from any device, individuals must explicitly opt-in. A secure process, including a consent procedure specifying data usage, purpose, and retention period, would be necessary.[136] This requirement aligns with Fla. Stat. § 501.711, which involves consumer protection and requires controllers to provide clear, annually updated privacy notices. This principle is critically important when applied to the sensitive and potentially deeply personal data collected by BCIs.[137]

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[131] *See Kyllo*, 533 U.S. at 40 (holding that police officers' use, without warrant, of thermal imaging device to detect heat from lamps used in marijuana growing operation, constitutes an unlawful search).
[132] *See id.*
[133] *See* Yuste et al., *supra* note 34, at 161.
[134] *See id.*
[135] *See id.*
[136] *See id.*
[137] *See* FLA. STAT. § 501.711(2023) (mandating that controllers provide consumers with clear and annually updated privacy notices detailing the processing of personal data, including sensitive and biometric data, and outlines consumer rights regarding data use and sharing).

This commitment to transparency and consent stands in contrast to notable privacy breaches in the digital realm, such as the incident with Facebook, where it was revealed that the company tracked users beyond their log-out, breaking its promise of privacy.[138] Similarly, Google's actions, bypassing user settings to track through cookies despite assurances to the contrary, serve as cautionary tales.[139] These examples underscore the paramount importance of upholding truthful communications and respecting user preferences in handling personal data.

Another possible solution is to safeguard the mental integrity of BCI users.[140] "Mental integrity should be understood as the individual's control of their mental states and brain data . . . [ensuring] that without their consent, no one can read, spread, or alter such states and data . . . to condition the individual in any way."[141] Devices capable of interfering with mental integrity should include functional limitations.[142] First, BCIs must integrate mechanisms that identify and alert users of the device of unlawful intrusion, modification, and distribution of neural data and activity.[143] Second, BCIs should be designed to thwart unauthorized access, changes, and transmission of brain-related information and functions.[144] "This should not only concern individual [BCI] devices, but act as a general (technical) operating principle shared by all interconnected systems that deal with decoding brain activity."[145] Although Fla. Stat. § 501.711 primarily addresses broader data privacy concerns, its emphasis on explicit notifications for the processing or sale of sensitive or biometric data underscores the need for heightened user consent and awareness in the context of BCI technologies.[146]

The idea is that BCI devices should be legally required to include protection systems tailored to their specific functions and uses.[147] This approach aims to achieve two primary objectives: (1) ensuring that users are aware of the activities occurring during their engagement in interacting with the

[138] *See* Davis v. Facebook, Inc. (In re Facebook Inc. Internet Tracking Litig.), 956 F.3d 589, 601 (9th Cir. 2020) (holding that plaintiffs have standing to bring claims for privacy invasion, intrusion, breach of contract, and claims under the Wiretap and California Invasion of Privacy Acts because there is evidence of privacy harm).
[139] *See* Calhoun v. Google LLC, 526 F. Supp. 3d 605 (N.D. Cal. 2021); *see also* In re Google Inc., 806 F.3d 125, 153 (3d Cir. 2015) ("A reasonable factfinder could conclude that the means by which defendants allegedly accomplished their tracking, i.e., by way of a deceitful override of the plaintiffs' cookie blockers, marks the serious invasion of privacy contemplated by California law."). *See generally* Hammerling v. Google LLC, 615 F. Supp. 3d 1069 (N.D. Cal. 2022).
[140] *See* Lavazza, *supra* note 53, at 55.
[141] *Id.*
[142] *See id*.
[143] *See id.*
[144] *See id.*
[145] *Id.*
[146] *See* FLA. STAT. § 501.711 (2024).
[147] *See* Lavazza, *supra* note 53, at 55.

neurotechnological devices, and (2) avoiding any unintentional restrictions on users' freedom and autonomy by utilizing these devices.[148] The broader legal framework provided by Fla. Stat. § 501.716 offers valuable guidelines for the kind of regulatory environment that could effectively address the unique challenges posed by BCIs.[149] For instance, Fla. Stat. § 501.716 outlines permissible exemptions for data processing that, while general, highlight the importance of balancing user privacy with the legitimate interests of technological and scientific advancement.[150] Implementing this standard necessitates careful consideration of BCIs, their applications, and their implications to raise public awareness.[151] This heightened awareness will, in turn, enable policymakers to develop relevant rules and laws to address these concerns.[152]

Conversely, this strategy still presents the possibility that unauthorized third parties can obtain sensitive neural information derived from consenting participants.[153] Non-neural data from sources such as online searches and shopping habits could be employed to draw accurate conclusions about those who opt against sharing their personal details with these third parties.[154] This highlights the need for robust data protection measures and user-awareness initiatives to minimize unintended data exposure to these providers and empower individuals to make informed choices about their privacy rights. For that reason, commercial use and transfer of neural data should be strictly regulated to mitigate this issue.[155] Similar to the laws preventing the commercialization of human organs, such as the National Organ Transplant Act of 1984, these regulations would decrease the likelihood of individuals trading their private neural information or obtaining it for financial profit.[156] Establishing these protections ensures that mental privacy remains a priority and can act as a safeguard against unauthorized third-party access using financial incentives to entice unsuspecting victims, especially for individuals tempted to resort to such measures in desperate financial situations. Furthermore, these regulations help balance the unequal bargaining power between the average individual and companies with extensive influence. In doing so, this measure can cultivate trust in using neural data and promote responsible, ethical practices that ultimately benefit individuals and society.

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[148] *See id*.
[149] *See* FLA. STAT. § 501.716 (2024) (providing exemptions for certain uses of consumer personal data, allowing for the processing of such data under specific circumstances, such as compliance with legal obligations, protection of consumer safety, and the facilitation of scientific research).
[150] *See id.*
[151] *See* Lavazza, *supra* note 53, at 55.
[152] *See* id.
[153] *See* Yuste et al., *supra* note 34, at 161.
[154] *See id*.
[155] *See id*.
[156] *See* National Organ Transplant Act of 1984, 42 U.S.C. 274e (1994); *see also* Yuste et al., *supra* note 32, at 161.

VI. PUBLIC OPINION, TECHNOCRATIC OATH, AND NEURORIGHTS

A. PUBLIC OPINION

Public opinion can significantly influence how bioethical principles and ethical theories are applied to emerging technologies such as BCIs.[157] In addition, a society's collective perspectives and values can shape the development, implementation, and regulation of such technologies.[158] Therefore, understanding public opinion is crucial to ensure that something adequately addresses ethical concerns and that the technology is accepted and integrated responsibly.

To illustrate, the Pew Research Center surveyed public opinion on using BCIs in individuals without a specific medical need for the device.[159] The results showed that many Americans are concerned about using BCIs to enhance cognitive abilities.[160] For instance, most respondents expressed concern about the technology rather than enthusiasm and viewed it as morally unacceptable rather than acceptable.[161] Moreover, there was a difference in attitudes among diverse religious groups, with those with a strong religious commitment being more inclined to view BCI technology as interfering with nature.[162] Additionally, a significantly higher number of people expressed that they were unwilling to utilize this BCI device personally compared to those who would willingly opt for the implantation of the device.[163]

First, the results of this study incline that most people express concern about using BCIs for non-medical purposes implicating the bioethical principle of autonomy; policymakers and researchers may be prompted to develop guidelines and regulations that prioritize an individual's choice to use or not use such technology.[164] In doing so, they would ensure that BCIs are employed in a manner that respects personal decisions and values.

Second, public opinion can influence the principles of beneficence and nonmaleficence.[165] However, suppose public opinion leans towards concerns about the possible harm caused by BCIs, as exemplified in this study. In that case, there may be calls for stricter regulations or even a halt in developing such

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157 *See generally* Jennifer Flynn, *Theory and Bioethics*, STAN. ENCYC. OF PHIL. (Nov. 25, 2020), https://plato.stanford.edu/cgi-bin/encyclopedia/archinfo.cgi?entry=theory-bioethics (exploring ethical dilemmas in bioethics at the intersection of theory and practice).
158 *See id.*
159 *See* Cary Funk et al., *U.S. Public Way of Biomedical Technologies to 'Enhance' Human Abilities*, PEW RSCH. CTR., 53–68 (July 26, 2016), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2016/07/PS_2016.07.26_Human-Enhancement-Survey_FINAL.pdf.
160 *See id.*
161 *See id.*
162 *See id.* at 58.
163 *See id.* at 67.
164 *See id.* at 53.
165 *See* Funk et al., *supra* note 159, at 53.

technologies, such as expressed above about developers asking for a halt in AI development to ensure the well-being and safety of individuals.[166]

Third, distributive justice, another bioethical principle, can also be impacted by public opinion.[167] If society is concerned about the unequal distribution of benefits and resources related to BCI technology, it could lead to the development of policies that ensure fair access to the technology, reducing disparities between different socio-economic groups.[168] In like manner, public opinion can shape how the ethical theories of utilitarianism and deontology are applied to BCIs.[169] The application of utilitarian principles may be a viable option if people believe that the benefits of using BCIs outweigh the potential risks.[170] Alternatively, if public opinion further suggests that BCIs violate moral duties or human dignity, deontological principles may be applied before an ethical evaluation is undertaken.[171] Therefore, considering the collective perspectives and values of a society can enable policymakers, researchers, and neurotech industry leaders to work together to develop and implement these technologies in a manner that respects ethical concerns and promotes responsible innovation.[172]

B. THE TECHNOCRATIC OATH: DO NO HARM

The availability of BCIs may also create professional duties for people in high-risk professions, such as surgeons, soldiers, or pilots, to utilize this technology regardless of reasonable uncertainties about their safety and efficacy.[173] Nonetheless, even from a libertarian perspective, there is a prevalent critique of BCI being used for enhancing cognition.[174] This criticism stems from wealthier individuals having greater access to mental enhancement procedures, while those with lower incomes will not, leading to increased social inequalities.[175] However, the unequal distribution of resources is also evident in other aspects of our society, such as disparities in access to essential nurturing, healthcare services, safe shelter, and quality education. Above all, these

[166] *See* Metz & Schmidt, *supra* note 105.
[167] *See* Ming Hsu et al., *The Right and the Good: Distributive Justice and Neural Encoding of Equity and Efficiency*, 320 SCI. 1092, 1092 (2008) (discussing the neurobiological basis of distributive justice and the interplay between equity and efficiency in decision-making processes).
[168] *See id.*
[169] *See generally* Zhi Xing Xu & Hing Keung Ma, *How Can a Deontological Decision Lead to Moral Behavior? The Moderating Role of Moral Identity*, 137 J. BUS. ETHICS 537, 537–49 (2016).
[170] *See id.*
[171] *See id.*
[172] *See generally* BCI PIONEERS (2022), https://www.bcipioneers.org (explaining how the BCI Pioneers Coalition is a digital forum that establishes ethics and best practices for BCI research studies).
[173] *See* Paolo Sommaggio, *Neuroscience, Neurolaw, and Neurorights*, *in* PROTECTING THE MIND 2020, at 78 (Pablo López-Silva & Luca Valera eds., Ethics of Sci. and Tech. Assessment Ser. No. 49, 2022).
[174] *See id.*
[175] *See id.*

neurotechnological medical procedures pose a potentially vast market opportunity, offering substantial financial incentives for pharmaceutical companies and healthcare professionals who may be drawn to join the profitable BCI sector.[176]

Additionally, some scholars have suggested a Technocratic Oath that is directly inspired by the Hippocratic Oath, a commitment sworn by physicians embarking on their medical careers.[177] The Hippocratic Oath has traditionally guided medical professionals toward ethical and responsible practices despite not being legally binding.[178] By comparison, the Technocratic Oath aspires to create a framework of moral standards that support conscientious progress while preserving the basic civil liberties of individuals.[179] Here, the proposed Oath could be sworn by students and employees involved in creating BCI technologies and neural data analysis software.[180]

The Technocratic Oath is founded on seven ethical principles, also commonly found in AI ethical guidelines.[181] These principles include: (1) non-maleficence, ensuring that technology is not intended to cause harm; (2) beneficence, aspiring to contribute to the common good through one's work; and (3) autonomy, emphasizing that participants' voluntary consent is needed for the participants involved. Furthermore, the Technocratic Oath highlights: (1) justice, stressing the importance of generating fair and unbiased outcomes from BCI and neurotechnology applications; (2) dignity, acknowledging that all individuals should be treated with the utmost respect and integrity; (3) privacy, pledging to remove sensitive and identifiable information from collected data; and (4) transparency, committing to make algorithms as clear and adaptable as possible.[182] By embracing these principles, practitioners can foster a culture of responsible innovation, guaranteeing that technological progress respects human rights and promotes the betterment of society as a whole.

C. NEURORIGHTS

Several advances in neuroscience were still being developed when the Universal Declaration of Human Rights (UDHR) was adopted in 1948.[183] When the document was created, it tackled various concerns about justice, transparency, and privacy in broad phrases, addressing a spectrum of matters that

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[176] *See id.*
[177] *See* María Florencia Alamos et al., *A Technocratic Oath, in* PROTECTING THE MIND 2020, at 163 (Pablo López-Silva & Luca Valera eds., Ethics of Sci. and Tech. Assessment Ser. No. 49, 2022).
[178] *See id.*
[179] *See id.*
[180] *See id.* at 169.
[181] *See id.* at 169–70.
[182] *See id.* at 170–71.
[183] *See* Clara Baselga-Garriga et al., *Neuro Rights: A Human Rights Solution to Ethical Issues of Neurotechnologies*, *in* PROTECTING THE MIND 2020, at 159 (Pablo López-Silva & Luca Valera eds., Ethics of Sci. and Tech. Assessment Ser. No. 49, 2022).

needed to be considered.[184] Nevertheless, the emergence of neurotechnology and its applications in BCIs and AI has introduced innovative complexities that demand specific considerations, especially in creating adequate public policies.[185] As a result, existing ethical protocols for addressing potential violations in technology around neuroscience need to be revised to keep up with the ever-changing technological advances over the coming years and decades.[186]

In response to these apprehensions, a team known as the Morningside Group, comprised of twenty-five global specialists in specific technological fields, has devised what they claim to call a set of neurorights.[187] These rights' primary purpose is to safeguard individuals' personhood during this age of rapid technological advancement.[188] "While the neurorights were drafted to be universal, the Morningside Group did [consider] that different cultures and traditions would have different perspectives on [addressing] ethical challenges posed by [BCIs] and neurotechnology."[189] Hence, to mitigate these concerns, the group suggested that every country appoint a diverse panel of experts from different disciplines to transform these rights into policies, eventually becoming the foundation for legislation.[190] "Specifically, the group has proposed the creation of five key neurorights: the right to personal identity, the right to free will, the right to mental privacy, the right to equal access to cognitive enhancement technologies, and the right to protection against algorithmic bias."[191]

Under this established framework, these protections would work in unison to enhance or refine established global human rights.[192] In addition, they would preserve elements like individuals' worthiness, autonomy, security and personal privacy, impartiality, and equitable treatment under the legal system.[193] On that basis, these neurorights can serve as a vital foundation for fostering responsible and equitable neurotechnology development across the globe. Thus, while acknowledging the need for cultural and regional adaptability, these neurorights can strive to safeguard the ethical theories of utilitarianism, deontology, and virtue bioethics.

By extension, utilitarianism is supported by the neurorights' focus on equal accessibility to neuroenhancement technologies and safeguards against

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[184] *See id.*
[185] *See id.*
[186] *See id.*
[187] *See generally Mission*, THE NEURORIGHTS FOUND., https://neurorightsfoundation.org/mission (last visited Apr. 20, 2024) (detailing advocacy for human rights and ethical considerations in neurotechnology); *see also* Baselga-Garriga et al., *supra* note 183, at 159.
[188] *See Mission*, *supra* note 187.
[189] Baselga-Garriga et al., *supra* note 183, at 159.
[190] *See id.*
[191] *See* Wajnerman & López-Silva, *supra* note 72, at 142.
[192] *See id.*
[193] *See id.*

algorithmic bias.[194] These provisions aim to reduce societal inequalities and promote the well-being of all individuals, regardless of their background.[195] In like manner, deontology is reflected in the focus on personal identity, free will, and mental privacy.[196] These rights establish ethical boundaries for neurotechnology developers and users, ensuring that they respect each individual's inherent value and dignity.[197] Lastly, virtue ethics is exhibited by promoting the responsible and equitable development of neurotechnology by encouraging individuals and organizations to cultivate virtues such as fairness, empathy, and responsibility in their decision-making processes.[198]

VII. CONCLUSION

The astonishing progress in neurotechnology and BCIs has transformed the possibility of how we interact with the world around us, offering unprecedented opportunities to improve our lives. However, this rapid advancement also raises a myriad of ethical concerns and challenges. By examining the issue through the lenses of utilitarian and Kantian ethical theories, we can navigate the complex landscape of BCI technology with greater moral clarity.

Utilitarianism, which focuses on maximizing overall happiness and minimizing suffering, would suggest that BCIs can be ethically justified if their benefits significantly outweigh their potential harms.[199] The possibilities of improving human capabilities, treating neurological disorders and neuropsychiatric diseases such as depression and addiction, and enhancing our quality of life are all points in favor of the continued development of BCIs.[200] Recognizing that BCI technology alone will not create a world entirely free from these challenges is essential. However, by combining BCIs with other interventions and support systems, we can work towards a future where these conditions are more effectively managed, promoting greater inclusivity and well-being.[201] It is also imperative to consider and mitigate the risks associated

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194 *See generally* Julia Driver, *The History of Utilitarianism*, STAN. ENCYC. OF PHIL, https://plato.stanford.edu/entries/utilitarianism-history (last modified Sept. 22, 2014) (providing an overview of the history and development of utilitarianism as a normative ethical theory).

195 *See id.*

196 *See generally* Larry Alexander & Michael Moore, *Deontological Ethics*, STAN. ENCYC. OF PHIL., https://plato.stanford.edu/entries/ethics-deontological (last modified Oct. 30, 2020) (deontological ethics emphasizes duty over consequences, asserting that some actions are inherently right or wrong).

197 *See id.*

198 *See* Hursthouse & Pettigrove, *supra* note 113.

199 *See* Driver, *supra* note 194.

200 *See* Abiri et al., *supra* note 31, at 6; *see also* Maia Szalavitz, *Brain Implants to Treat Addiction Are Dangerous and Promising*, VICE (May 5, 2020), https://www.vice.com/en/article/qj4d4w/brain-implants-to-treat-addiction-are-dangerous-and-promising (discussing the potential of deep brain stimulation (DBS) in treating addiction and the ethical concerns that arise from this technology).

201 *See* Greenbaum, *supra* note 85, at 665–66 (discussing the potential harm and ethical concerns of

with privacy, autonomy, and potential abuse of power to ensure that these advancements do not inadvertently lead to greater suffering.[202]

On the other hand, Kantian ethics emphasizes the importance of respecting human autonomy and treating individuals as ends in themselves rather than as mere means.[203] This perspective raises concerns about the potential for BCIs to undermine individual autonomy and privacy, with implications for human dignity.[204] To address these concerns, it is crucial to establish regulations and safeguards that ensure the ethical development and use of BCIs while preserving individual rights and autonomy.[205] For that reason, the ethical principles guiding BCI neuroscience and its related medical practices should incorporate a Kantian principle of treating humankind as an end rather than a mere means.[206] This outlook suggests that the primary objective of neuroscience and its associated medical practices should be preserving and enhancing human autonomy.[207]

As we continue to explore the frontiers of neurotechnology and BCIs, it is our collective responsibility as a society to consider both the potential benefits and ethical dilemmas they present. It will be crucial for researchers and prominent players in the neurotech BCI field to remain vigilant and actively engage with the diverse communities that will utilize these innovations.[208] By fostering relationships with these groups, we can better anticipate the cultural shifts that will inevitably arise from adopting these BCI technologies and ensure we approach these changes cautiously.

Here, we find ourselves at a turning point where we can learn from past mistakes and draw insights from adjacent medical technologies, breakthroughs, and similar situations to address concerns related to social inequity and the

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protecting the user of BCI and its attached devices from biocybersecurity threats, and the need for cyber professionals to monitor emerging hacks and outreach programs to inform neuroscientists of the dangers of BCIs).

[202] *See* Istace, *supra* note 38, at 101 (discussing that regulatory actions may be required to mitigate the risks associated with neurotechnological developments).

[203] *See* Apaar Kumar, *Kant on the Ground of Human Dignity*, 26 KANTIAN REV. 435, 435 (2021) (discussing Kant's perspective on the basis of human dignity).

[204] *See* Shen, *supra* note 128, at 669 (mentioning past scholars who voiced their fear of brain-imaging technology being used as a nonconsensual mindreading device).

[205] *See* Wajnerman & López-Silva, *supra* note 72, at 142 (discussing how foreign governments have begun proposing ways to "regulate neurotechnological developments").

[206] *See* Arran Gare, *Ethics and Neuroscience: Protecting Consciousness, in* PROTECTING THE MIND 2020, at 31 (Pablo López-Silva & Luca Valera eds., Ethics of Sci. and Tech. Assessment Ser. No. 49, 2022) (arguing that the Hippocratic Oath should include Kantian principles "to treat humanity as an end to itself" and not a means to an end).

[207] *See id.* (suggesting that the goal of medical practices is to maintain and augment human autonomy).

[208] *See* NEUROTECHX, https://neurotechx.com/ (last visited Apr. 24, 2023) (announcing themselves as a non-profit organization that facilitates neurotech advancement through resources, learning opportunities, and leadership in technological initiatives incorporating their three pillars of the community, education, and professional development).

needs of disability communities.[209] By embracing research methods such as community-based participatory research and tapping into the knowledge of the communities that benefit from these technologies, we can maximize the potential for success while minimizing potential pitfalls.[210] Furthermore, by engaging in thoughtful discourse and informed decision-making, conversant with ethical theories such as utilitarianism and Kantian ethics, we can help shape this field's future in a manner that respects human dignity, autonomy, privacy, and well-being. Accordingly, balancing the principles of beneficence and non-maleficence will be essential in ensuring that our progress does not result in the unintended creation of our own Frankenstein monster.

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[209] *See id.*
[210] *See id.* (offering "accessible resources . . . to inspire and create neurotechnology that benefits all of society").