The Ethical Significance of Brain-Computer Interfaces as Enablers of Communication

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Abstract

This article argues that the primary ethical significance of brain-computer interfaces (BCIs) lies not in the specific content they transmit, but in their capacity to restore communicative agency to individuals otherwise excluded from ethical engagement due to conditions such as complete locked-in syndrome. While current ethical frameworks focus largely on risks, privacy, and clinical outcomes, this analysis foregrounds the ontological dimension: BCIs safeguard and re-establish the practical conditions under which autonomy, recognition, and interpersonal accountability can be exercised. Drawing on documented clinical cases, the article applies the concept of communicative reinstatement to describe how BCIs reconfigure relationships between patients, caregivers, and the broader moral community. The argument culminates in a normative claim: societies have an ethical obligation to maintain and protect communicative capacity where feasible, treating BCIs not merely as therapeutic tools but as infrastructures of moral inclusion. This reorientation carries implications for regulation, informed consent, policy, and distributive justice.

Keywords: Brain-computer Interfaces, Communicative Reinstatement, Moral Personhood, Locked-In Syndrome

Introduction

Brain-computer interface (BCI) technology has emerged as one of the most ethically consequential developments in contemporary medicine and neurotechnology. Much of the public discourse surrounding BCIs has centered on high-profile commercial ventures—such as Elon Musk's Neuralink—and the controversies these projects generate. These controversies include the ethics of animal testing protocols, speculative claims regarding human enhancement and human-AI symbiosis, and the broader societal implications of merging minds with machines.[1] While these debates are significant, there is a more fundamental ethical dimension inherent to BCIs. They constitute a novel class of moral technology that reconfigures the very possibility of communicative agency for individuals with severe disabilities.

[1] Perez, C. (2025, June 23). The Advancements and Ethical Concerns of Neuralink. *The Princeton Medical Review*. https://medreview.odus.princeton.edu/2025/06/23/the-advancements-and-ethical-concerns-of-neuralink/

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The current ethical literature predominantly analyzes BCIs through two prevailing frameworks. The first treats them as medical devices warranting standard risk-benefit analysis, assessing safety, efficacy, and clinical outcomes.[2] The second framework situates BCIs within the emerging field of neuroethics, emphasizing concerns about privacy, cognitive liberty, data security, and the potential for manipulation.[3] Although previous work has already emphasized the ethical importance of BCIs in restoring communicative capacities, this paper develops the claim further by foregrounding what may be termed the ethical function of BCIs.[4] Their significance lies not just in enhancing particular interactions or reducing barriers, but in re-establishing the very possibility of communication, through which individuals assert their will, can participate in community, and be recognized as interlocutors. In this sense, BCIs are ethically constitutive, since they sustain the conditions under which autonomy and accountability can be expressed. Following this reasoning, this paper argues that the primary ethical significance of BCIs lies not in the specific content they transmit or in the circumstances under which they are implanted, but in the fact that they render transmission possible at all.

To develop this argument, the paper first examines documented clinical cases of BCI-mediated communication in locked-in patients. These cases show how BCIs reconfigure ethical relationships among patients, caregivers, and society by transforming patients from passive recipients of care into more active participants. Subsequently, the paper considers the broader implications of this ethical perspective for clinical practice and policy, especially regarding long-term maintenance obligations.

The central claim is that BCIs should be understood not merely as therapeutic tools but as infrastructures of moral inclusion, generating ethical duties to establish, maintain, and protect communicative capacity where feasible.

BCIs as a Way to Restore Communication

The ethical significance of BCIs becomes most evident in the context of complete locked-in syndrome (CLIS), a condition in which patients retain cognitive awareness but lose all voluntary muscle control. Traditional assistive technologies relying on residual movements, such as eye-tracking systems, become ineffective under these circumstances. Intracortical BCIs, by contrast, can restore communicative capacity by directly decoding neural signals associated with intended speech or movement.[5] One landmark study documented an amyotrophic lateral sclerosis (ALS) patient who, after entering CLIS, learned to use an implanted BCI speller to construct sentences at a rate of approximately one character per minute. The patient's communications ranged from the mundane, such as

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[2] Lavazza, A., Balconi, M., Ienca, M., Minerva, F., Pizzetti, F. G., Reichlin, M., Samorè, F., Sironi, V. A., Navarro, M. S., & Songhorian, S. (2025). Neuralink's brain-computer interfaces: medical innovations and ethical challenges. *Frontiers in Human Dynamics, 7*, Article 1553905. https://doi.org/10.3389/fhumd.2025.1553905

[3] Christiansen, T. (2025). The future of medicine or an ethical nightmare? Elon Musk's Neuralink and the advent of brain-machine interfaces. *Fall 2021, Spectrum*. https://voices.uchicago.edu/triplehelix/2025/01/02/the-future-of-medicine-or-an-ethical-nightmare-elon-musks-neuralink-and-the-advent-of-brain-machine-interfaces/

[4] Burwell, S., Sample, M., & Racine, E. (2017). Ethical aspects of brain-computer interfaces: A scoping review. *BMC Medical Ethics, 18*, Article 60. https://doi.org/10.1186/s12910-017-0220-y

[5] Chandler, J. A., Van der Loos, K. I., Boehnke, S., Beaudry, J. S., Buchman, D. Z., & Illes, J. (2022). Brain computer interfaces and communication disabilities: Ethical, legal, and social aspects of decoding speech from the brain. *Frontiers in Human Neuroscience, 16*, 841035. https://doi.org/10.3389/fnhum.2022.841035

requesting music, to expressions of existential significance involving care preferences.[6] Importantly, when researchers were asked how they would respond if the patient spelled "unplug my ventilator," they emphatically stated that BCI output would not determine decisions regarding life support withdrawal. This position reflects appropriate clinical caution but also reveals a critical ethical distinction. While the content of BCI-mediated communication requires verification and contextual interpretation, the very fact that said communication occurs transforms the patient's moral status from a passive recipient of care to an active participant in ethical dialogue.[7]

A comparable case involved an electrocorticography (ECoG) based BCI, which restored communication for a patient previously reliant on eye movement interpretation with limited accuracy. This patient gained the ability to produce verified short phrases and, among the first communications, corrected care team assumptions about personal preferences. Such moments fundamentally reconfigure the ethical relationship, shifting the patient from an object of interpretation to a subject capable of self-representation and autonomous expression.[8]

These cases share the same ethical pattern: the BCI's biggest impact is not the specific messages it transmits but its role as the enabler of transmission itself. This transition from silence to speech might be termed "communicative reinstatement," the re-entry of a person into a moral community through restored capacity for expression.

Different Dimensions of BCI Ethics

Traditional ethical frameworks for medical devices focus predominantly on what we commonly refer to as the "concrete dimension," addressing concrete outcomes, risks, and clinical applications. For BCIs, this focus materializes in debates over whether to honor euthanasia requests (where legal) communicated through neural implants or concerns about data privacy and cognitive liberty. While these concerns are valid and urgent, they fail to capture the more "fundamental dimension," which is how BCIs alter the conditions of moral personhood by restoring the capacity to communicate.

From a philosophical standpoint, the concrete pertains to particular instances such as the content of a patient's message, technical specifications, or safety reports. The fundamental, by contrast, concerns the foundational preconditions that make communication and moral agency possible. This distinction bears significant ethical weight. For example, consider a patient with locked-in syndrome who can communicate "I am in pain" through a BCI. In this scenario, caregivers and clinicians must deliberate on how to interpret and respond to the patient's expressed experience. In contrast, if the patient lacks any means of communication, no such ethical deliberation can occur because the patient's perspective remains inaccessible to the moral and caregiving community. In this latter case, the BCI functions ethically by creating the very possibility for ethical engagement where none previously existed.

This fundamental perspective also shows why device failure or abandonment inflicts harm that transcends mere technical malfunction. Clinical reports describe psychological trauma among patients who lost access to BCI

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[6] Chaudhary, U., Birbaumer, N., & Ramos-Murguialday, A. (2016). Brain-computer interfaces for communication and rehabilitation. *Nature Reviews Neurology*, 12(9), 513–525. https://doi.org/10.1038/nrneurol.2016.113

[7] Holz, T., Kübler, A., & Birbaumer, N. (2023). Brain–Computer Interfaces, Completely Locked-In State in Neuroethics. *Neuroethics*, 16(1), 1–12. https://doi.org/10.1007/s11673-023-10256-5 ; Sankary, L. R., Ford, P. J., Machado, A. G., Hoeksema, L. J., Samala, R. V., & Harris, D. J. (2020). Deep brain stimulation at end of life: clinical and ethical considerations. *Journal of Palliative Medicine*, 23(4), 582–585. https://doi.org/10.1089/jpm.2019.0129

[8] Sellers, E. W., & Donchin, E. (2006). A P300-based brain–computer interface: initial tests by ALS patients. *Clinical Neurophysiology*, 117(3), 538–548. https://doi.org/10.1016/j.clinph.2005.06.027

functionality due to corporate discontinuation, comparable to the loss of a sensory organ.[9] This harm is not simply empirical or technical but ethical and existential, since it represents the collapse of a reconstructed mode of engagement and involvement with one's community as a speaking subject. Such cases underscore that BCIs are not simply devices but essential conditions for sustaining moral agency and personhood.

Obligations of Maintenance and Moral Inclusion

From this understanding emerges an ethical imperative. If BCIs can restore communicative agency, and if communicative agency constitutes a foundation of moral personhood, then society holds an obligation to provide and maintain technologies that enable such restoration wherever reasonably possible. This obligation extends beyond traditional medical ethics in three key respects.

First, it recognizes communicative restoration as a distinct ethical good, irreducible to conventional therapeutic aims focused on curing disease or alleviating symptoms. BCIs address a deeper deprivation, namely, the exclusion from the communal domain where moral relations and agency occur.

Second, this obligation entails durable responsibilities extending beyond initial implantation. Communicative capacity depends on sustained technical support, ongoing software updates, and user training, demands that challenge existing models of medical device regulation and healthcare infrastructure. Historical cases of early BCI users abandoned by manufacturers exemplify the grave ethical costs incurred when these responsibilities are neglected.[10]

Third, the imperative to restore communication reshapes informed consent practices. Traditional consent protocols emphasize risk disclosure and benefit assessment, but BCI users face a unique transition from communicative isolation to reinstatement that is difficult to fully apprehend in advance, especially by healthy individuals. Ethical consent must therefore encompass this experiential dimension to genuinely respect autonomy.

This imperative does not demand that BCIs be provided at any cost but prioritizes communicative reinstatement as a fundamental ethical goal in clinical practice, research, and policy. Just as society accepts obligations to provide language education or accommodations for disabilities, it must recognize a corresponding obligation to establish and maintain technologies that restore basic communicative capacity.

Policy, Practices, and Objections

Recognizing BCIs as infrastructures of moral inclusion rather than mere medical devices also requires reconsideration across multiple policy domains. Regulatory frameworks that currently evaluate BCIs mainly for safety and efficacy must be expanded to include assessments of reliability in enabling nuanced expression, guarantees of long-term continuity, and interoperability standards that prevent vendor lock-in. Funding models must evolve beyond traditional reimbursement schemes ill-fitted to support the sustained maintenance and upgrading necessary for BCI functionality. Innovative approaches might include insurance categories recognizing "communicative benefit," public-private consortia dedicated to maintenance, or endowment funds ensuring long-term support. Ethics oversight bodies, including institutional review boards, require new frameworks tailored to the unique challenges of communicative reinstatement research. These include enhanced consent protocols addressing phenomenological

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[9] Poppe, C., & Elger, B. S. (2024). Brain-Computer Interfaces, Completely Locked-In State in Neurodegenerative Diseases, and End-of-Life Decisions. *Journal of Bioethical Inquiry*, 21(1), 19–27. https://doi.org/10.1007/s11673-023-10256-5

[10] Bottorff, E. (2025). The Aftermath of Abandoned Neurotech: Ethical and Regulatory Challenges in the Dawn of Brain-Computer Interfaces. *Knowing Neurons*. https://knowingneurons.com/abandoned_neurotech/

shifts, mandatory plans for post-trial access, and contingency measures against commercial abandonment. Finally, legal recognition must evolve to address the evidentiary status of neural signals as expressions of intent, protections against compelled device use, and rights to device continuity.

These policy reforms formalize an ethical recognition of communicative capacities as constituting a fundamental human good that technologies like BCIs can restore, imposing corresponding social and legal obligations to protect this capacity.

Counterarguments

Several objections to this framework merit consideration. One common argument prioritizes therapeutic intervention aimed at curing disease rather than investing in assistive communication technologies. This objection falsely dichotomizes care, since communicative reinstatement often facilitates more effective therapeutic collaboration and patient-centered outcomes. Another concern involves technological risk, as invasive BCIs entail surgical and medical dangers. Yet as non-invasive alternatives continue to advance, ethical risk-benefit assessments must weigh these risks against the profound psychological and social harms of communicative isolation.

Skeptics could point to interpretive challenges, noting that BCI output represents an imperfect proxy for thought. However, all communication involves interpretative acts; ethical standards should require basic intelligibility sufficient to respect autonomy rather than perfect fidelity. Finally, distributive justice objections might cite the high cost and limited access to BCIs. This is principally an implementation challenge, paralleling the historical trajectory of other assistive technologies, which initially faced similar barriers before becoming more widely accessible.

While these concerns highlight genuine practical difficulties, they do not undermine the core ethical argument that communicative reinstatement via BCIs constitutes a distinct and critical moral good.

Another issue concerns the temporality of access. For many patients, even temporary use of BCIs may provide immeasurable benefit, restoring participation and recognition for a limited period rather than not at all.[11] Yet reliance on devices that may later be discontinued, abandoned, or unsupported raises serious ethical risks of dependency and loss. At the same time, requiring companies to guarantee indefinite support could deter development or delay availability. Ethical evaluation must therefore balance the immediate benefits of temporary communicative access against the structural vulnerabilities introduced by uncertain long-term provision.

Conclusion

In conclusion, Brain-Computer Interfaces demand an ethical paradigm shift that recognizes their capacity to restore persons to the moral community through communicative reinstatement. By redirecting analysis from the concrete, what is communicated, to the fundamental, that communication occurs at all, BCIs are shown not to be mere medical devices but as infrastructures of moral inclusion. This ethical status generates corresponding obligations to develop these technologies responsibly, maintain them reliably, and prioritize communicative restoration as a fundamental human good. As BCI technologies advance, ethical frameworks must evolve accordingly to protect not just the users of these devices but the communicative capacities they enable, the essential threads that connect human beings as moral persons.

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[11] Blain-Moraes, S., Schaff, R., Gruis, K. L., Huggins, J. E., & Wren, P. A. (2012). Barriers to and mediators of brain-computer interface user acceptance: Focus group findings. *Ergonomics, 55*(5), 516–525. https://doi.org/10.1080/00140139.2012.661082