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Homo Prostheticus: Theological and Ethical Implications of Brain-Computer Interface Technology

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Introduction—Sounds of the Future

"You sound like a glockenspiel!" These were the first words spoken by my daughter Ashley, in response to my words, "I love you," moments after her cochlear implant was activated, restoring the hearing she had gradually lost in her twenties as she became deaf. The technology of her implant is truly amazing, even if the quality of electronically simulated speech is unlike natural hearing. A tiny microprocessor behind her ear translates sound waves into electrical impulses and relays them to her brain by a wire threaded through her skull and deep into the inner ear, where it stimulates the auditory nerve. Restoring her hearing has changed her life. It has allowed her again to flourish, both socially and professionally. Through technology, a father whose words are music is now delighted to have what she whimsically refers to as a cyborg daughter.

Technologies that unite brain networks with computer circuitry continue to advance and astonish. Noland Arbaugh is a young man of the same generation as my daughter. At age twenty-two, he sustained a severe spinal cord injury from a swimming accident and became permanently quadriplegic, with complete paralysis and loss of sensation in his limbs. When he learned that Elon Musk was seeking volunteers for an investigational brain-computer interface (BCI), he applied, placing his trust in the entrepreneur famous for pushing the boundaries of technology. "The dude's done so many amazing things," he remarked in an interview.[1] In January 2024, Arbaugh became the first human to be implanted with Musk's Neuralink device. "It's always cool to be the first at anything," said Arbaugh, who is now enabled to move a computer cursor by thought.

Problematic Questions Arise

Even a cursory look at the implications of BCI technologies is to peer into a Pandora's box of problems. Questions arise not only for medicine, neuroscience, and computer engineering, but also for ethics, law, sociology, philosophy, and theology. The questions are too numerous to address comprehensively here, but in order to orient the reader to the complexity of the topic, a few deserve mention. What are the bioengineering possibilities? What additional neurological deficits might future technologies overcome? What are the acceptable and unacceptable risks to health? As the technology advances, who should have access to it? Should there be boundaries around acceptable use, and who decides? Should BCI use be limited to restoring health, or should we also permit use for enhancing human capabilities beyond what is possible naturally? Which human capacities should we value? Should we embark on radical projects to redesign humanity? How far should this technology go, and to what ends?

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If these questions make your head spin, you are not alone. In order to address them, more than an understanding of technological feasibility is needed. We must take a step back and ask, what is the brain in relation to the mind, and what does it mean to connect it with technology? Only then can answers to some of the ethical questions begin to come into focus, even as more questions inevitably will come. This essay The discoveries of neuroscience have not proven the brain to be essentially a computer, and to regard it as such would be tragic.

What Is the Human Brain?

We often hear of the brain described as analogous to a computer, defined functionally by its electrochemical activity in the same way that a computer consists of an assembly of electrical chips and circuit boards. Computers, so goes the narrative, are silicon-based replicas of what the brain happens to do with carbon-based molecules. Along this line of thinking, a fictional concrete-thinking neurosurgeon in the 2006 television drama *3 Lbs*[2] quipped that the brain is just "wires in a box."[3]

However, to think of the brain only in terms of its electrical activity is to greatly oversimplify its structure and function and to mistake its nature. The human brain is far more complex than any computer. It consists of a hundred billion neurons, each of which has, on average, some three thousand synaptic connections with other neurons—some as many as one hundred and fifty thousand connections. The brain is not reducible to cellular "wires." Within its inner recesses flow precise chemical exchanges of neurotransmitters and neuropeptides. Its synaptic connections are endowed with dynamic plasticity that selectively modifies their strength of communication. The mathematical implications of such rich connectivity are staggering. The number of synapses in the brain exceeds a hundred trillion. Thus, the number of functionally unique possible brain states is many orders of magnitude more than the number of elementary particles in all the universe.

There is much that neuroscience does not understand and cannot explain about the human brain. This is especially true regarding the nature of consciousness and nondeterministic behavior such as personal agency or free will.

The Brain and the Technical Grid

Whereas conventional technologies, such as electroencephalography (EEG), detect patterns of the brain's electromagnetic activity by recording from the scalp surface, Neuralink penetrates further into the cerebral cortex. The technology is quite remarkable. First, the skin is sliced open, and a hole is drilled into the skull. Then, a coin-sized electronic hub with more than a thousand electrodes is inserted and placed over the cerebral cortex. Projecting from it are sixty-four tiny flexible threads, each containing a bundle of minuscule wires, which are sewn into the cerebral cortex by a robot with tiny mechanical fingers in order to avoid puncturing arteries, so intricate is the procedure. The result is more than three thousand electrodes that record signals within a small slice of brain—for Arbaugh, in the motor cortex corresponding to intentional hand movement.

BCI research is actively pursuing functional limb prostheses and targeting still other brain regions with exciting prospects for restoration of lost function. Recent efforts to decode the neural activity underlying language have led to early yet ground-breaking developments in computers' ability to detect intended speech, offering hope to patients who, as the result of stroke or neuromuscular paralysis, are locked in.[4]

For patients who are minimally conscious, a language neuroprosthesis that bypasses the motor apparatus of audible speech would be a welcome clinical tool, enabling those who have lost the capacity for communication again to relate to others and to interact with their environment.[5] Innovative research is taking place also in technology to restore sight to the blind.[6] A subretinal photovoltaic implant has been developed to treat macular degeneration.[7] A bionic vision system that captures images and transmits signals directly to the brain's visual cortex has entered into human clinical trials in Australia.[8] Image resolution is low but is expected to improve with further developments.[9]

The brain's highly complex interconnectedness means that a thought is not just one discrete unit that can be captured by an electronic sensor. A word or phrase in the brain's language network is dynamically associated with other thoughts. Words may be associated with visual memories, influenced by the imagination, shaped by reason, guided by forethought, driven by desire, hindered by anxiety, arrested by fear, or inspired by hope. Whether a feasible BCI of the future might tap into multiple interrelated brain processes simultaneously is uncertain, but it should be kept in mind that increasing the number of contacts would multiply the invasiveness of the surgical procedure.

Presented with such revolutionary medical applications, it may be easy to overlook the inherent surgical risks. BCIs are not just another type of cool wearable device. They are invasive machines surgically implanted through a craniotomy. The potential risks of brain surgery are numerous and can include infection, hemorrhage, inflammatory reactions such as foreign body response, tissue heating, stroke, seizures, headaches, lead migration, lead disconnection, attenuation of effect over time, and unwanted effects of stimulation on targeted or adjacent brain tissue, including altered mental states. Currently, the device-related complication rate for deep brain stimulation by one or two electrodes is 2.7–3.4%.[10]

Rodolfo Llinás, an academic neuroscientist, proposes threading an array of nanoscale wire electrodes into the intricately arborizing cerebrovascular network in order to gain access to large numbers of neurons deep within the brain.[11] Such a procedure would avoid the need to drill a hole through the skull but could substitute other surgical risks. To be safe, these innumerable "wiretaps" penetrating into the brain must be biocompatible.[12] The long-term risks, which might include vascular perforation causing hemorrhage into the brain, are nontrivial and largely unknown.[13]

In bridging technical barriers, projects intended to fuse the human with his artifact probe the conceptual distinction between man and machine. At the single nerve level is the cochlear implant, which utilizes a multichannel microprocessor to extract sounds from the environment. The device detects pressure waves carried by air and converts them into digital signals that are conveyed as electrical pulses to the auditory nerve. The brain must then relearn to hear as it interprets environmental sounds in a new way. The sounds are qualitatively different, something like a musical piece played on a new

type of musical instrument, but meaning is preserved. Building on that technology, BCIs tap into other brain functions. Whereas the cochlear implant sends auditory stimuli to be received by the brain passively, the Neuralink device taps into voluntary motor output. Thus, more advanced future BCIs as mediators of intentional motor output could potentially render determinations of causal agency ambiguous. It might be unclear whether it was the person or the computer initiating the action. "The computer made me do it" could become a catch phase.

BCIs are quite a remarkable accomplishment, given the staggering complexity of brain signals, which a team of biomedical engineers has described as a "nearly impenetrable coding jungle."[14] Representing brain function within the circuitry of a digital prosthesis is like modeling a small slice of a three-dimensional structure in only two dimensions. Notably, the output is incomplete. Digital computers are deaf to the brain's higher-order analog processes and blind to its abstract concepts. There are domains of human thought experienced in the first person that are utterly undetectable and forever indecipherable by computational machine technologies.

Even more fantastic technologies are emerging. A novel research paradigm implants cerebral organoids[15] into damaged brains of laboratory animals with the goal of enhancing connectivity via organoid-brain-computer interfaces.[16] More than technical expertise about feasibility and safety is needed to evaluate such biotechnology. In order to calibrate our moral compasses in this bold new world of challenging questions, a valid philosophical framework is needed. For that framework to lead to blessings rather than curses, I submit that it should be informed by theological principles informed by the Bible.

Theological Considerations

Does demonstration that a human brain can be functionally connected to a computer mean that our brains likewise are just computers, our minds just molecules, our patients just physical bodies—rather than embodied souls? Are human persons a body-soul unity according to the traditional Christian account, or has science dispelled the myth of the immaterial by offering a convincing assessment of humans as fully reducible to their physical bodies? Regardless of how one answers this question, linking metal to mind tends to reframe our plausibility structures of human nature reductionistically in terms of matter and energy. The BCI is a physical device, and if it is used in ways that touch on personal identity or moral agency, then it matters whether humans are more than physical entities. Thus, in assessing BCI technology, healthcare professionals should consider not only the science but also the nature of patients under our care.

For the Christian, the doctrine of the *imago Dei* is an enduring theological north star. The book of Genesis describes the creation of human beings differently than that of the "creeping things and beasts of the earth" (Gen 1:24, ESV) and declares that God created humankind uniquely "in his own image" (Gen 1:27a). Nowhere does Scripture apply this label to any other living creature, nor to any humanly crafted artifact. This means that the most important conclusions to be drawn about the appropriate use of BCIs in humans extend beyond what can be learned from animal models or technology.

Efforts to define precisely the *imago Dei,* which all humans bear and which sets humans apart from all other animals, have not identified a universally recognized biomarker. Among the traits that distinguish humans from other animals are abstract reasoning, planning for the future, intentional decision-making, symbolic language, wearing of clothing, altruism, and spirituality. Some argue that rudimentary evidence of these traits can be found in some animal species, one example being vocal labeling by dolphins, elephants, and monkeys as an elementary form of symbolic language. Others argue that, as measured by abstract intelligence, humans stand apart not only in degree but in kind. To the extent that these traits are definable by physical criteria, increasingly they have been replicated by computational machines. The thoroughgoing materialist would be mistaken, however, in attempting to explain the significance of the *imago Dei* in purely physical terms within reach of and, potentially, manipulation by BCIs.

The *imago Dei* is not a physical, but rather a theological concept relevant to the creation, fall, redemption, and sanctification of humankind. The Bible does not define the *imago Dei* in terms of attributes, capacities, traits, or abilities, which differ in degree among individual members of the human species. Rather, the Christian tradition has long understood the *imago Dei* as the basis for being in relationship with God. Theologian John Kilner offers an elevated definition of the *imago Dei,* asserting that it "has to do with being created to conform to who Christ is as the image of God."[17]

Competing Models of Human Nature

What is man, that God is mindful of him, and his brain, that his electronic tools might interconnect with him? Analogous to the boundary between person and machine that BCIs in some sense bridge is the philosophical debate over competing models of human nature. One perspective is what philosopher J. P. Moreland and ethicist Scott Rae define as "substance dualism," which is "the view that the soul—I, self, mind—is an immaterial substance different from the body to which it is related."[18] "Immaterial" refers to that which exists but is not physical matter. An example of something that is real but not material is abstract mathematics; equations and geometric shapes exist in the mind as meaningful ideas but are not physical things that one can touch. "Substance" refers to a thing that exists, in contrast to a "property," which is an attribute that a substance may have. Regarding the human person, Moreland and Rae distinguish substance, which they define as "a continuant that remains the same through change," from a property-thing (i.e., an assembly of properties), which "does not sustain absolute identity through change of properties or parts."[19] If the human soul were a property-thing, they argue, then personal identity over time would not be possible because bodily cells normally undergo replacement over a lifetime. You might not now be the same person your parents brought into the world!

Dualists recognize that our bodies, to which BCIs and electronic wearables attach, is also, in some way, constitutive of our identity. In defining substance dualism, Moreland writes that "the human person is comprised of a soul (a fundamental, immaterial/spiritual substance) and a physical body, capable of existing without a body, but not without his/her soul, and the mental life of which is possessed and unified by his/her soul."[20] Philosopher Matthew Owen writes that it is the body that distinguishes contemporary

views of dualism from Cartesian dualism: "a human person is a hylomorphic object consisting of soul and body. Furthermore, the body is essential to a human person."[21]

By contrast, philosopher-theologian Nancey Murphy, psychologist Malcolm Jeeves, and philosopher Warren Brown hold that persons are purely physical entities. They appeal to science, which they believe has explained the soul away by providing physical explanations of mental processes. Whereas these physicalists recognize the starkly atheistic implications of an anthropology that radically reduces humans to matter, yet as Christians, they maintain that humans, though having no immaterial nature, are nonetheless more than the sum of their parts. In an effort to reconcile physicalism with Christian theology, they advance a "nonreductive physicalism" model, which proposes that higher-level physical properties emerge from complex lower-level interactions of cellular matter.[22] These emergent properties of mind, they reason, are what science compels us to believe define humanity in physical terms, in contrast to what used to be understood as the soul. But is this truly a scientific conclusion, or is it a philosophical assertion?

Body-Soul Dualism Is a Long-Held Model

Moreland points out that substance dualism accords with the common experience of freedom and personal identity and has withstood the test of time. He writes, "the overwhelming majority of educated and uneducated Christians throughout history have been dualists" who believe in the immaterial soul.[23] Belief in the soul is not just an academic question. It "has implications for the practice of medicine," writes theologian Todd Daly, "where virtues like faith, fortitude, hope, patience, and love (ideally) inform and uphold this most sacred enterprise."[24]

A medical ethos that would regard humans as bodies without souls sends shudders down the spine. The historian Richard Weikart reminds us that the history of medical ethics is a series of lessons in the tragic consequences of relinquishing belief in the soul and regarding human beings as simply physical objects. Weikart draws our attention to the ethicist Joseph Fletcher, who holds to a functionalist view, asserting that "human beings are not persons from the moment of conception or even the moment of birth; rather, they gradually develop into persons. By that view," writes Fletcher, "some humans are persons, and others are not."[25] Having defined personhood by physical criteria, Fletcher promotes euthanasia, and by similar reasoning ethicist Peter Singer justifies the option of infanticide.[26]

Has Neuroscience Disproven the Soul?

BCI technology draws from neuroscience, which supposedly has rendered the soul implausible. Detailed physical descriptions of brain states correlating with human thought have become the prevailing account of human mental processes previously attributed to an immaterial soul.[27] Jeeves writes of the "ever tightening links between mind and brain"[28] signaling a paradigm shift, such that "theological affirmations about the human person cannot ignore the findings of science."[29] Likewise, molecular biologist Francis Crick asserts that "You, your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact *no more than* the behaviour of a vast assembly of nerve cells and their associated molecules."[30] Confidently, philosopher Patricia Churchland concludes that "the weight of evidence now implies that it is the *brain,* rather than some nonphysical stuff, that feels, thinks, and decides. That means there is no soul."[31] Is the question of the soul truly settled, or should we, with Moreland, lament this shift to reductionism?[32]

We must be careful not to confuse correlation with causation. Moreland and Rae explain that "the brain and the mind/soul are two different things or substances: the brain is a physical thing that has physical properties, and the mind or soul is a mental substance that has mental properties."[33] Accordingly, scientific investigation of physical properties of the brain can tell us much about neurochemistry, but it cannot directly detect an immaterial mind/soul.[34]

Literary scholar C. S. Lewis cuts through the philosophical fog with clarity by affirming the reality of an immaterial mind in his "argument from reason." The mind that reasons "must be able cognitively to stand apart from nature to comprehend nature. If mental processes were dictated solely by a deterministic chain of causation," he writes, then we "could have no reason to believe that scientific insights into nature are true and trustworthy rather than just a reflection of the way the brain's molecules happen to interact."[35] On this basis, physicalism is self-refuting, "because it undermines the validity of reasoning, on which all possible knowledge depends."[36]

Incomplete Knowledge through Reductionism

The scientific portrait of human nature, though detailed, is incomplete, and to appreciate fully the nature of humanity, one needs sources of knowledge beyond the reach of science. Returning to Crick's blunt assertion, when he claims that personal identity reduces to so many molecules, his words "no more than" betray a prejudice that, from the onset, excludes any consideration of the nonphysical. This prejudice is not an empirical fact that can be demonstrated scientifically; it is a philosophical presupposition. Crick's thoroughly reductive physicalism, in the words of physicist John Polkinghorne, "destroys rationality. Thought is replaced by electro-chemical neural events. . . . The very assertions of the reductionist himself are nothing but blips in the neural network of his brain."[37]

Moreland rejects reductionistic assertions as "irrelevant" to the evaluation of immaterial substance.[38] If the mind/soul is immaterial, then science (its method being limited to the physical) can neither access nor exclude it.[39] With philosopher William Lane Craig, Moreland reminds us that science is not the exclusive source of all knowledge. Abstract reason, wisdom gained through reflection, and divine revelation in Scripture also are sources of valid knowledge that present truths undetectable by empirical methods and that are, therefore, unassailable by technological innovations.[40]

Moreover, human knowledge is limited. Science awaits additional discoveries, and faith in an infinite God acknowledges further depths of knowledge (Isa 55:9). Ethicist C. Ben Mitchell and colleagues contend that, when scientists argue for a purely physical anthropology, they are "imposing their view of the world on their work and drawing metaphysical conclusions that simply cannot be drawn from their field of expertise."[41] Philosopher David Aiken agrees: "Settling metaphysical disputes by appeal to the latest scientific data . . . confuses the explanatory

categories of the sciences with those of philosophy."[42] Thus, exclusion of dualism is not a scientific verdict; it is a philosophical assertion.

In place of evidence, physicalists propose a curious model. Conceding that a radically reductionist account of human nature is incomplete, Christian physicalists seek to rescue human nature by introducing a higher functional property layer. Murphy agrees with dualists that the eliminative materialist philosophy of Crick and Churchland, grounded in atheism, "is utterly unacceptable to the Christian."[43] In place of the immaterial soul, Murphy proposes a nonreductive physicalism, which theorizes a higher-level property—mind—that emerges from the complexity of the physical brain and causally influences the brain in a "top-down" manner, in contrast to deterministic "bottom-up" chains of causation at the levels of atoms and neurons.[44]

Even nonreductive physicalists acknowledge the metaphysical to a point but, in the end, settle on empirical neuroscience and the prestige it confers. Jeeves concedes that "there are certainly great scientific benefits in the reductionistic approach as a methodological stance, but not as a metaphysical one."[45] Murphy agrees that "no amount of evidence from the neurosciences can ever prove dualism to be false or physicalism true."[46] At first glance, these statements seem to agree with substance dualists that science is unqualified to answer metaphysical questions about the soul. Elsewhere, however, these same scholars appeal to science as definitive support for their metaphysical stance. Jeeves writes that "dualisms of parts or substances will not do. There is no scientific evidence for them."[47] In refrain, Murphy writes, "if we take nonreductive physicalism to be not merely a philosophical thesis, but also the hard core of a scientific research program, there is ample scientific evidence for it."[48] Having cracked open the door to the metaphysical, physicalists have then drawn it shut, allowing in only science.

Physicalists' inconsistent statements relating science to metaphysics expose a weakness in their model. The claim that science validates nonreductive physicalism because it has not shown it to be false is logically fallacious.[49] Absence of evidence for a soul is not evidence of absence.[50]

Note the philosophical sleight of hand. Having asserted that science is the ultimate authority by which to understand human nature, these scholars then conjure from the physical an emergent mind, but this mind is not a scientifically defined property that can be objectively detected and verified; it is a rationalized philosophical construct.

Does nonreductive physicalism as a philosophical principle succeed in rescuing human nature from the reductionism of the physical sciences? And is it ethically sufficient for the healing professions? The physicalist account, though nonreductive, is still physical, and it falls under the spell of "scientism," which is the mistaken view that the exact sciences supply "the only genuine knowledge of reality."[51] Moreland calls nonreductive physicalism "weak scientism" in that it "acknowledges truths apart from science, granting them some minimal rational status," but when one gets right down to it, regards science as "by far the most authoritative sector of human knowledge."[52] Thus, weak versus strong scientism is a distinction without a difference. Philosopher Gordon E. Carkner sums up why weak scientism fails: it is essentially "a metaphysical claim about the impossibility of metaphysics."[53]

The physicalist view is also ethically suspect because its embrace of scientism renders value judgments meaningless. Physical descriptions might show how the brain reasons, but they cannot establish how it should reason. "Nor can a scientific description limited to factual knowledge about the brain inspire the care of the sick or resolve difficult dilemmas in medical ethics," wrote this author, adding that "a materialistic appraisal of human nature would thus impoverish medicine. The obligations to love one's neighbor (Lev 19:18; Mark 12:31) and serve one another (Gal 5:13) would make little sense if the ethos of healthcare were based on the lonely view that patients are essentially churning aggregations of molecules."[54]

Physicalists slip into a philosophical category error by explaining consciousness not as a substance but as a property derived from other properties. For example, Brown explains consciousness as "emergent in a sense from our brain function," adding that "patterns of electrical activity modulating over the surface or in the cerebral cortex . . . give us that moment of consciousness."[55] Paying close attention to his language, who is the "our" and the "us" that possesses this consciousness, if not the soul as the bearer of mind and identity?

Personal Identity Through Time

By denying substance, which remains the same through physical change, physicalism invalidates the central Christian doctrine of a bodily resurrection, in which the person who is resurrected in Christ is the same person who died. Theologian Scott Smith writes that, if we are "just a bundle, or set, or physical properties," then when Jesus' body died on the cross, *"Jesus the human person also died* (i.e., ceased to exist). Now, if humans are physical things, then the Jesus who died is not identical with the Jesus who was raised, for their respective bodies had different properties. That implies that Jesus did not survive his death on the cross."[56] Smith continues: "for it seems [that according to physicalism] we too cannot survive our deaths and be resurrected."[57] Similarly, the Apostle Paul writes that, "if there is no resurrection of the dead, then not even Christ has been raised" (1 Cor 15:13).

Aspects of personal identity essential to Christian theology include the capacities for belief, free will, and moral responsibility. An unresolved problem for physicalism, writes Aiken, is "whether responsible agency and the capacity for moral self-transcendence can be adequately understood as emerging from the material conditions under which they operate."[58]

Murphy acknowledges that personal identity over time is a difficult question if there is no soul,[59] while affirming the "reassembly view."[60] Here, "the entire person simply disintegrates at death, to be recreated by God at the general resurrection."[61]Moreland, however, challenges Murphy's claim of mereological essentialism as just an assertion for which she provides no justification.[62] If the person is no more than "a mereological aggregate" (a system comprising parts), then it loses identity when its parts are altered and has a different identity if its parts are reassembled.[63] The dualist view, by contrast, holds that the person is an essence that endures despite accidental changes to its physical features[64] Referring to the resurrection, Paul writes of the mystery that not a reassembled body but "this mortal body must put on immortality" (1 Cor 15:53). In this life, physicians minister

not to aggregates of molecules but to people who, though they will die, yet shall live (John 11:25).

Implications for BCIs

The astute reader will notice that the three strands of discussion thus far, the technical, the philosophical, and the theological, are complementary. They converge at questions of how to think about linking computers to the brains of human beings who are constituted by bodies, minds, and souls. Viewing humans holistically, scientific data cannot tell us all we need to know to make good decisions about BCI applications. Viewed through a technological lens, the line distinguishing persons from computers blurs. If technology alone is in focus, then persons may seem to be downgraded to the status of machines.

It bears emphasizing that persons are not simply aggregates of matter with brains that can intertwine with electrodes and seamlessly integrate with computers. If persons are more than their physical brain states, then there are immaterial aspects of humanity intangible to BCIs, which detect and interact with only the brain's electrical signatures. It follows that a BCI might probe or even manipulate neuronal function, but it cannot directly tap into or alter the *essential* identity of the immaterial mind or soul. As a corollary, if the mind is not an epiphenomenon of a nonreductive physicalist process, then we should not expect computers that have reached a certain level of complexity to thereby become conscious beings.

BCIs do, however, have the potential to alter a person's *accidental* identity, which is contingent on physical influences on the brain or body that, while not changing one's essential identity, can influence perceptions of the world, desires, or beliefs. In this sense, BCIs are like psychopharmaceuticals[65] or transcranial magnetic stimulation,[66]although they are more directly invasive. The full potential of BCIs is, therefore, difficult to forecast.

Human beings are more than molecules. They are embodied souls. For physicians entrusted with life-or-death matters in the care of suffering souls, physicalism offers no adequate ethical basis for compassion, empathy, and concern for those whom we should love as Jesus does. Regardless of the language used to describe persons, we are called to love our neighbors (Matt 22:39), not as material aggregates, and not as plug-in modules, but as fellow persons. By restoring lost language or mobility, a BCI might enable someone to express love better, but it can never be the source of love. If a BCI alters one's accidental identity, the aim should be to restore or preserve one's essential identity.

A Proposed Ethical Framework

To help navigate difficult questions about the use of technology, ethicist Michael Sleasman proposes an ethical framework consisting of four categories.[67] One prefers a world with less technology. Another likes technology too much. A third seeks a just-right balance but overlooks the values needed to know where that balance should lie. The fourth is the way of wisdom and responsibility. In unpacking them below, note that each draws from different presuppositions about what it means to be human and leads to different conclusions about BCI applications.

Technological Sentimentalism

The technological sentimentalist instinctively resists technological innovation. Neuralink, bionic eyes, and cochlear implants seem to be a further step along a path that is already fragmenting human communication as we attach ourselves more and more to smartphones and find it difficult to unplug from electronic connectivity. They are attentive to how current communication technologies seem to erode kindness in how we treat others, as if people were machines. They worry that connecting more directly with computers might mean disconnecting from people. They are nostalgic about what is remembered as a more natural way of inhabiting the world. Of course, someone in need of an implant to restore lost function is unlikely to be a pure sentimentalist.

Technological Messianism

Technological messianism is the opposite of sentimentalism. This perspective regards all technology as intrinsically good and desirable. It applauds the prospect of restoring communication and mobility to a quadriplegic to improve his quality of life. The optimism of technological messianism traces to the European Enlightenment, which elevated reason as the supreme means by which we can understand the universe and obtain progress. Unless guardrails are imposed, technological messianism tends to assess technology uncritically, overlooking unintended bad consequences and conceding to a form of fatalism that says if it can be done, it is inevitable that it will be done, and therefore it might as well, or even should be, done.

As an example, an electronics engineer writes of BCIs: "Inspired by its benefits, the society needs to seize the available opportunities that the technology advocates."[68] The phrasing "technology advocates" suggests a technological imperative, as if the BCI device had personal agency of its own. Consider also this comment by a neurosurgeon: "No neuron is safe from a neurosurgeon. We can really go anywhere in the brain with considerable safety. We can either drive a circuit, or we can suppress pathologic activity within circuits."[69]

Technological messianism opens a door to the philosophical movement known as transhumanism, which looks to technologies such as BCIs as the means to re-engineer humanity in order to overcome existing human limitations and enter into a radically different posthuman future.[70] To the Enlightenment project, the given human body is an obstacle to the will to power. If one believes that human nature is the product of an undirected evolutionary process whereby chance mutations favorable to survival prevailed, then there would seem to be no reason we should not take control of human evolution if technology gives us the powers to do so, or so the argument goes. A 2002 manifesto on *Converging Technologies* published by the National Science Foundation explicitly recommends technology as "an important next step in human evolution."[71] One of its authors writes, "we may not have yet reached our final evolutionary form. Since we are still evolving, the inescapable conclusion is that nanotechnology can help drive our evolution."[72] Another writes, "What will human-like intelligence evolve into if it is freed from the limits of the human meat-machine, and humans can change and improve their own hardware? It's hard to say. . . . No death. You back yourself up. You get new hardware as needed."[73]

It would be easy to dismiss such preposterous assertions as bizarre, fringe, or sci-fi dreaming if they were not published by mainstream (and well-funded) experts. Elon Musk, the tech billionaire who cofounded the company that produced Neuralink, confides that "the long-term aspiration with

Neuralink would be to achieve a symbiosis with artificial intelligence."[74] How far from humanity as we know it is transhumanism poised to go? Julian Savulescu, a neuroethicist, predicts that "Humans may become extinct. . . . We might have reason to save or create such vastly superior lives, rather than continue the human line."[75]

We must be discerning, scientifically and theologically. As Christians, we know who the Messiah is (John 10:27). When he returns, retaining the human nature that he took upon himself as the incarnate Son of God, what version of humanity will he find on earth (John 1:14; Phil 2:6–10)?

Technological Pragmatism

The pragmatic perspective, which is the prevailing attitude among secular ethicists today, looks to usefulness as the ultimate measure of right and wrong. A pragmatic approach to BCIs calculates how much benefit is possible for how many people and balances that against how much harm might occur. The answer is a risk-assessment calculation. In ethical theory, pragmatism is a form of utilitarianism, and it has certain blind spots of which we should be aware. Pragmatism is appealing because it seems objective, but it presupposes that empirically verifiable physical facts are the only valid knowledge. This is an illusion, for it omits value assessment and the immaterial. How should we measure good? How do we define better? Is it to maximize pleasure, speed, or relationships? Is it right to implement a technology that causes a small minority to suffer harm if, on the balance, a greater number benefit? Adrift from any shared concept of values, pragmatism tends to descend into moral relativism. To live as a secular pragmatist is to live as though there is no God. But, as Solomon reminds us, pleasure ultimately is meaningless (Eccl 2:1), and higher purpose may be found in the wise but not always pragmatic, approach of fearing God and keeping his commandments (Eccl 12:13; Prov 1:7). Biblical wisdom towers over our expedient plans.

Technological Responsibilism

The responsibilism approach to ethics recognizes that technology is not neutral, as is commonly assumed, but is laden with the values of its human designers and implementers. The applications of technologies such as BCIs may also be shaped by—or shape—the values of its users. In promoting human flourishing, it matters therefore what one believes it means to be human. For the Christian considering whether to implant or to receive a BCI, an attitude of biblically informed responsibilism usually does not provide simple yes or no answers but prompts questions of discernment. As the human is not reducible to his or her material constituents, the person receiving a BCI is not a material extension of a technological apparatus but an embodied soul bearing the image of God. For this reason, ethical decisions about the use of BCIs must be made after careful reflection, with great care, and with reverence for the *imago Dei*.

If you were to receive a brain chip, would its functions enable you to do justice, love kindness, and walk humbly with your God (Mic 6:8)? Would your new capabilities ennoble your character? Would you have the option of switching off a BCI that enhanced sensory information from your environment? Would a BCI that piped streams of information introduce noise to distract from your prayer life? If a BCI connected to artificial intelligence were to anticipate your thoughts or mediate your actions, could you be certain they were your own?

Future direct brain-to-brain electronic connections might render some of one's private thoughts transparent, just as, before a word is spoken, Psalm 139:4 tells us that God knows it altogether. But would removing the veil of privacy truly enhance human communication? Would you feel comfortable letting someone else browse your most personal thoughts if the implant took away your ability to filter them? Elon Musk has said that he wants to use Neuralink to speed up the rate of communication between people by a factor of a thousand.[76] Scripture, on the other hand, cautions Christians to be "slow to speak, slow to anger" (Jas 1:19; also Prov 14:17).

Looking forward, technology that taps into memories and fears might one day cure posttraumatic stress disorder or panic disorder, which would be welcome developments. However, the same technology might also be used by authoritarian regimes to monitor and control political or religious thought or to provoke targeted panic. Could such applications be prevented, were the technology to be developed? Could attainment of such power be trusted?

Christian responsibilism appreciates the reality of human sin and recognizes the potential perils of allowing BCI technology to drift in whatever way it may. Unless one has a valid moral compass, downhill descents are more probable than heavenly ascent. Responsibilism also guards against what may be the greatest danger of BCIs: hubris. If we are to address the numerous ethical questions raised by BCIs in a way that pleases God, promotes rather than obstructs the Holy Spirit's formation of Christlike character in our minds, and helps us to serve our neighbors, we require less hubris and more humility. That cannot be achieved by turning a knob on a device but only through intentional thought, reasoned reflection, compassionate engagement, and prayer.

Conclusion

Mr. Musk is correct that humankind needs an implant, but not the kind he thinks. BCI technologies represent one of the finest examples of what the Apostle Paul in 1 Corinthians called the "wisdom of this age or of the rulers of this age" (1 Cor 2:6), which in time will pass away. In contrast, believers in Christ have access to the "hidden wisdom of God" (1 Cor 2:7), so that "we might understand the things freely given us by God" (1 Cor 2:12). God has given us not a machine to insert into our heads but, through his Spirit, insofar as we abide in Christ (John 15:3-5), we have access to "the mind of Christ" (1 Cor 2:16). This is a wonderful mystery. Lesser substitutes will inevitably disappoint.

One aspect of having the mind of Christ, as Scripture reminds us over and over again, is that we should not fear. Rather than just compute what is digitizable, calculable, feasible, and monetizable, we are commended to think on whatever is true, honorable, just, pure, lovely, commendable, and worthy of praise (Phil 4:8).

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