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Technoscientific Rationality: Navigating Dilemmas in the Contemporary Zeitgeist

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Abstract

The symbiotic integration of science and technology, referred to as techno science, has become one of the defining features of the contemporary world. As a culture-shaping phenomenon, technoscience is overwhelmingly intertwined with society and the environment. It influences society's functions, including how we are present in the world; how we engage with ourselves and others; and how the world appears before us. Despite technoscience shaping our world at an unprecedented pace, it is vital to examine the mechanisms through which it constructs these realities. Thus, this paper explores the general spirit of our contemporary period—technoscientific rationality—and its dilemmas. In navigating this zeitgeist, I critically assess the dilemmas posed by technoscientific rationality. I contend that while technoscience plays a significant role in shaping and governing today's global order, it is misleading to view it as a totality. Instead, technoscience must be understood in terms of its mediating role within specific contexts, since it has different features in relation to the societies and environments it interacts with. Therefore, it is more insightful to delineate technoscience through specific human-world interactions rather than separating them into independent domains. The primary purpose of the paper is threefold: to examine the mediating role of technoscience in the contemporary human-world relationship; to uncover its dual nature as a 'pharmakon' – both panacea and malady; and to propose ethical and sustainable approaches for the future. To illustrate the complexities and dilemmas of technoscientific rationality, I focus on its interaction with contemporary Ethiopians, while employing a multi-method philosophical approach.

Keywords: Ethiopia, mediation, pharmakon, technoscience, technoscientific rationality
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Introduction

Technoscience, defined as a symbiotic integration between science and technology, has become one of the dominant defining features of contemporary society (Meskus, 2015; Channell, 2017). As a world-shaping phenomenon, technoscience overwhelmingly affects and is affected by various aspects of humanity. In fact, the impact of technoscience and its manifestations on different aspects of our lives and existence is evident and unprecedented (Haraway, 1997; Eneh, 2008; Levin & Mamlok, 2021). Hence, we cannot avoid the ubiquity of technoscience and its indelible impact. However, though technoscience has been shaping our world at an unprecedented pace, it is vital to accentuate the mechanisms through which it constructs these realities. Hence, the primary purpose of this paper is to analyze the polymorphous human-technoscience relationship and how they co-shape each other, since exploring them in their interaction is vital rather than isolating and approaching human beings and technoscientific artifacts in separate realms. By drawing attention to the impact of technoscience, the paper also places equal emphasis on the discussion of the zeitgeist of the milieu, namely, technoscientific rationality and its dilemmas. That is to say, as I navigate and grapple with the zeitgeist of the times, I will critically assess the dilemmas posed by technoscientific rationality.

Accordingly, I contend that while technoscience plays a significant role in establishing and governing the global order of our milieu, it is misleading to conceive of technoscience in its totality. Instead, technoscience should be perceived and analyzed in terms of its mediating role in a specific context. Put briefly, the mediating role of such artifacts is contextual. This is because technoscience exhibits distinct characteristics and plays various mediating roles in its specific interaction with society, such as in the environment that it influences and is influenced by. Hence, alongside enabling human beings to do specific things, technoscientific things are mediators in the relationship between human experience and the world. They shape the way human beings know and understand themselves and the world.

To accentuate this argument and engage with the zeitgeist of our contemporary era, this paper adopts a multi-method philosophical approach. This approach is well-suited to addressing the complexities and dilemmas of technoscientific rationality in today's context. Specifically, I will employ a critical approach and a speculative method to analyze and critique existing arguments concerning technoscience, while also proposing my own perspective and speculating on its implications. Additionally, I will integrate phenomenological and empirical methods to ground my argument in observable phenomena,

complemented by a thorough examination of various texts. Furthermore, an interdisciplinary approach will be applied to draw insights from other disciplines, enriching the analysis and broadening its scope.

This paper is structured into six sections. The second section briefly explores the essence of technoscience. The third section examines the relationship between technoscience and humanity, focusing on its mediating role and meaning. The fourth section discusses technoscientific rationality, exploring its various manifestations, including intellectual trends and the influence of technoscience. The fifth section addresses the concept of pharmakon, portraying technoscience as both a remedy and a malady, offering benefits while also posing challenges to human well-being. Finally, the sixth section provides recommendations for approaching technoscience in a way that fosters a sustainable and ethical future.

On the nature of technoscience: An overview

The term "technoscience" represents a relatively emerging idea that gained theoretical significance in the 1970s, leading to an increase in discourse regarding its nature (Prasad, 2017; Bensaude & Loeve, 2018). In fact, at first glance, technoscience simply seems to be the combination of two different words, namely: "techno" and "science". Nonetheless, it elicits an ambivalent view and has various connotations. Technoscience can be conceived in different ways. For instance, the proponents of the "nothing new" approach claim that technoscience is a contamination or distortion of pure science (Bensaude & Loeve, 2018). According to this approach, science is free from technology. Hence, science and technology are independent of one another (Price, 1965; Skolimowski, 1966). Grounded on this premise, they argue that technoscience is a postmodernist buzzword (Zwart, 2022). While others (Forman, 2007; Weber, 2010) assert that technoscience marks an "epochal break" with the past and is a reversal of the values between science and technology emphasizing the supremacy of science over technology. Alternatively, some scholars (e.g., Eneh, 2008; Tala, 2013; Channell, 2017; Bensaude & Loeve, 2018) argue that technoscience is the conflation of science and technology resulting from fundamental developments and epistemological shifts in both fields. Thus, it seems there is no agreement on how best to characterize technoscience. Put briefly, there is little consensus on its nature and scope. In light of this conceptual ambivalence, I conceive and defend the view that technoscience is a word used to describe the synergistic integration of science, technology, and society that emerges as a result of an evolutionary process in human activities. The roots of technoscience can be traced to changes in the epistemological investigations of science and technology.

The evolving interdependent relationship between science and technology highlights their dynamic and reciprocal nature. It challenges traditional views that regard science as purely theoretical and technology as merely its practical application. Contemporary developments show that science increasingly depends on technological methods and mathematical tools, while technology, in turn, drives scientific progress, demonstrating a continuous, two-way exchange between the two. This integrated relationship is best captured by the concept of technoscience, which dissolves the boundaries between science and technology and includes human and non-human actors (Schmidt, 2011). Technoscience reflects the hybrid, interconnected nature of contemporary knowledge production and better represents the reality of today's scientific and technological landscape than earlier models like the neutrality or dependency theses.

The mediating role of technoscience

Over the last five decades, technoscientific artifacts have moved from research laboratories into industrial production lines and monopolizing, effectively monopolizing almost every aspect of our lives (Channell, 2017). The ubiquity of technoscience is manifested in almost every part of our daily routines and different aspects of humanity, including shelter, food, clothing, health, communication, education, transportation, and so forth (Du Toit, 2005). We can claim that our daily lives would be difficult without technoscientific things since they contextualize everything (Reinel, 1999). In light of this, Raisinghani (2018) points out that:

> Our dependence on technoscience is evident in the extensive use of electronic gadgets in our everyday lives. It is as if we cannot eat, sleep, or move without them - "In each lived moment of our waking and sleeping, we are a technoscientific civilization" (Raisinghani, 2018).

Technoscientific artifacts are everywhere: with us, around us, under us, and above us. The omnipresence of technoscientific things is exhibited even before birth and after death (Meskus, 2015). In this regard, obstetric sonography or antenatal diagnosis is uses ultrasound devices to assess the health status of a fetus by ultrasound devices. Similarly, advanced post-mortem imaging (PMI) technoscientific artifacts such as computed tomography and magnetic resonance along with techniques such as x-rays, fluoroscopy, and endoscopy applied during digital autopsies and various anthropological examinations are good instances.

Thus, it is difficult, and likely impossible, to distance oneself from technoscience and its impact.

Moreover, technoscience is also an important agent of contemporary human transformation (Reinel, 1999). Its proliferation has the power to transform the political, economic, and social aspects of humanity in today's world. As I shall make clear below, it shapes the social processes and power relations of our contemporary world (Haraway, 1997; Reinel, 1999). Accordingly, as Meskus (2015) rightfully states, technoscience describes "contemporary societies and cultures in general" (2015, p. 2).

As indicated, we cannot avoid the indelible impact of technoscience on our lives. Technoscience deeply influences both personal identity and the structure of society, highlighting its pervasive role in shaping modern human life. The following section explores these impacts to show how thoroughly technology permeates our daily existence.

Technoscience and The individual: Shaping personhood

As mentioned elsewhere, we live in an era where technoscience is interwoven with our daily routines. The integration of technoscience in human life overwhelmingly affects our bodies, our subjective inner experiences, our perceptions, beliefs, and how we engage with ourselves, among others (Du Toit, 2005). By this I mean, technoscience is shaping the nature of human beings and our understanding of it (Meskus, 2015; Levin & Mamlok, 2021). In other words, it has become an integral part of human personhood and determines the exclusive features of humanity.

However, in order to uncover how technoscience and its gadgets are interwoven with human identity, a good starting point is focusing on the relationship between technoscience and humanity. To this end, a theory of "mediation," developed out of the work of Don Ihde (1990) and expanded by Peter Paul Verbeek (2005), can provide an in-depth study of the dynamics of human-technoscience relations.

This theory, in short, accentuates the co-constitution of people and their material world. When technoscientific artifacts are used, instead of being merely instrumental objects, they help to reshape the relations between human beings and the world (Ihde, 1990; 2009; Verbeek, 2005; 2015; 2016). In doing so, "they help shape how human beings can be present in the world, how we perceive ourselves, and also how the world can be present for us" (Verbeek, 2015:29). This theory provides a framework for dissecting the interaction between humans and artifacts.

There are various ways in which technoscience and its material manifestations organize human-world relationships—ranging from being a simple

tool to forming a hybrid being known as a cyborg. For instance, when some of them, like eyeglasses and a white cane, are embodied and form a unity with the human being, they become an extended part of the human body or perceptual faculties; others, like magnetic resonance imaging (MRI) scans or astronomical photography, are read to represent the world to us and used in (re)interpreting and (re)framing our perception of the world (Verbeek, 2015). Still, others play the role of "being interacted with"— we directly interact with technoscientific objects as an external reality. During such interaction the rest of the world fades into the background. Our relationship with voice assistants (e.g., Alexa) and customer-service chatbots are thought to be good examples of this relationship. Similarly, some technoscientific artifacts such as air conditioners (AC), artificial/electrical lighting, and heating are becoming part and parcel of the world. Hence, in such a case, the context of our experiences and actions is not seen as something alien to the world (Verbeek, 2015). There are also technoscientific artifacts combining the role of the above mentioned artifacts; for example, "smart glasses" can be embodied to give an experience of the world and also give a representation of the world. Again, there are tools that move beyond the functionality relationship and are immensely fused with the human body. These artifacts, in brief, create cyborgs.

The advancement of technoscientific processes, such as prosthetics, implants, and interventions, has increasingly blurred the boundaries between humans and machines. Devices like pacemakers, cochlear implants, and exoskeletons not only restore or replace bodily functions but also enhance human capabilities, extending the fallible human body (Verbeek, 2015).

This relationship between humans and technoscientific artifacts offers several key insights. First, technoscientific artifacts cannot be grouped into a single category; each has a distinct relationship with humans and a mediating role, which varies across cultures and experiences. For example, modern devices like air conditioners may hold different meanings for people from pre-electrical societies (Verbeek, 2008). Secondly, rather than viewing humans and technoscientific artifacts as separate domains, their relationship is one of interrelation, where subjectivity and objectivity shape one another (Verbeek, 2015). Finally, technoscientific artifacts do more than address practical needs; they actively shape how people understand the world and redefine what it means to be human. They mediate perception through tools like digital imaging, biomedical equipment, and wearable sensors, all of which influence how individuals experience their own bodies. They also play a role in how people form their identities, exercise agency, and occupy social roles. In these ways, technoscientific artifacts help shape how

individuals understand themselves and, ultimately, what it means to be a person (Levin & Mamlok, 2021).

As indicated, recent developments in technoscience have impacted human personhood (Weber, 2010; Du Toit, 2005; Levin & Mamlok, 2021). Although the human person is open to continuous change and transformation within itself (like the cells in our bodies) and in its environment, the impact of the technoscientific environment is unprecedented. Technoscience does not just enhance what humans can do, but it also transforms the very standards we use to understand what it means to be a person. They question long-held ideas about the body by making it possible to alter it technoscientifically; they shift our sense of agency by allowing algorithms and intelligent systems to take part in decision-making; and they reshape how identity is formed by making gender, appearance, and even cognitive abilities more open to technoscientific intervention or choice. In doing so, technoscience reshapes the cultural frameworks through which societies define a "human person," blurring the lines between natural and artificial, inherited and chosen, and biological and technical.

As a result of technoscience and one of its forms and techniques, specifically the convergence of Nanotechnology, Biotechnology, Information Technology, and Cognitive Science (NBIC), both the cognitive and physical capacities of human beings are transformed, corrected, enhanced, and substituted. They enable contemporary human subjects to restructure themselves. With the help of technoscientific advancements, individual human beings have begun to self-optimize as best as possible (Du Toit, 2005). Individuals are now able to redefine and reconstruct their identities through technoscientific progress and its various applications. One clear example is gender transition, where medical and technoscientific tools, like hormone therapy and various surgical techniques, help individuals change parts of themselves that were once thought to be unchangeable. These advances show how technoscience gives individuals new ways to reshape and express their identities. However, the significance extends beyond mere self-recreation; it also alters our understanding and definition of human personhood. For instance, it affects our perception and experience of what it means to transcend. Phenomena previously regarded as beyond human comprehension and control, such as gender selection, gender roles, and physical appearance, are increasingly viewed as malleable and subject to choice. Overall, this development positions humanity as if we have control over our own destinies (Du Toit, 2005).

In addition, people are integrating themselves with technoscientific gadgets and creating new identities known as cyborgs. Although entities characterized by human-machine symbiosis are commonly depicted in science fiction literature and

films, advancements in innovative technoscientific systems are transforming them into reality as individuals increasingly integrate with machines. The super-power, strength, speed, dexterity and senses of movie characters such as "Nyctalope," "Terminator," "Darth Vader," or "Borgs" in Star Trek are, for example, no longer left to imagination and fiction, rather they are already here with us. The emergence of cyborgs and the ability of advanced robots and artificial intelligence (AI) to replicate certain human values and activities, traditionally regarded as uniquely human, have consequently altered the definition of personhood. Along with an effective simulation of human features such as the ability to see, walk, hear, smell, taste, touch/feel, and so forth, even the inherent biological practices of human beings may soon be supplanted. In this context, reproductive cloning and electrogenesis (machine as a mother), where machines serve as maternal figures, exemplify the "mechanization of humans". The functions and abilities of artificial intelligence obscure the line separating humans from machines, consequently influencing our understanding of human nature (Mitchell, 1999).

The alteration of the nature of interconnectivity, communication and information by technoscience has also brought the replacement of the traditional concept of human beings as "a separate entity by a new ontological self-perception of human beings as an information organism" (Levin & Mamlok, 2021, p. 1). That is due to the fact that hyper-connectivity with the global community and the abundance of information influence an individual's experience and decision making.

The other point that needs to be mentioned in this regard is the identity crisis. By identity crisis, I mean different ways of identity formation and looking at oneself. Because of the advancement of online platforms and virtual spaces, contemporary individuals are confused about their identity and purpose (Meskus, 2015). People in the contemporary period exist not only in the physical mundane world but also very much in cyberspace (Cole, 1991). They build virtual identities as virtual representatives of themselves, what Rodogno (2011) called personal identity online (PIO). Such identity is manifested in the realm of email, e-commerce, e-shops, social-media platforms, video games and so forth. According to Rodogno (2011), cyberspace offers an opportunity and allows a person to create and exhibit a character that is different from their habitual "real" personality. Hence, a "virtual personality" is one form of personality formation, since a person develops their identity by themselves. This virtual representation of oneself transforms our sense of the self, as "the self has become, paradoxically, at once more distributed and more singular" (Meskus, 2015:2). People's identity therefore

remains a mixture of online and offline presence, which is sometimes owned not only by the individuals themselves, but also by varying central authorities.

The influence of technoscience on human identity also pertains to the cultivation of virtuous character traits. In today's environment, particularly among children, there is a tendency to emulate fictional characters from movies or television rather than looking to esteemed figures from real life as models for behavior (Du Toit, 2005). Characters from science fiction books and movies (more sensuous and corporal, representing the visual image and spoken word) become role models for developing virtuous characters in real life. This also alters the identity formation of contemporary human individuals.

In general, as the study of the interaction between technoscience and humanity indicates, the mediating role of technoscientific gadgets is not only altering our perception of the world, but it also alters our understanding of the very nature of ourselves. Particularly, cyberspace (web-presence) and AI influence the nature of pre-digital personhood. Moreover, as discussed above, it creates a new ontological state of humanity (Levin & Mamlok, 2021:3). As a result of technoscientific pervasiveness and "technoscience fetishism," I want to take this observation further and argue that in the future people may say "because technoscience, therefore I am" in expressing themselves.

Technoscience and society: Transforming the fabric of our world

Technoscience has created a virtual cyberspace that reshapes how people relate to themselves and others, fostering a networked, communicative consciousness (Levin & Mamlok, 2021; Acerbi, 2019). This digital shift drives cultural changes by mediating nearly all aspects of social experience and behavior (Acerbi, 2019). The advancement of digital technologies, therefore, becomes a potent agent of change in contemporary society (Kastenhofer & Molyneux-Hodgson, 2021). Its impact on different systems such as information and communication, banking, the market, transportation, education, health services and so forth is significant. The emergence of the COVID-19 pandemic has significantly highlighted this reality. During the lockdowns, individuals across the globe relied on digital devices to carry out various activities.

The pervasive impact of technoscience is evident across various aspects of contemporary society (Levin & Mamlok, 2021). Through digital tools such as social media, email, and chat applications, technoscience has transformed global interconnectedness and reshaped communication, politics, economy, religion, and education (Raisinghani, 2018). Platforms like, Facebook and Twitter, influence political engagement and policymaking, while also serving commercial, religious,

and academic functions. Education, in particular, has undergone a major shift toward digital learning through tools like e-books, online classes, and blended learning formats. Technoscience also enables active societal participation; individuals now generate content, share information, and contribute to a decentralized, open communication system (Prasad, 2017). This shift fosters cultural diversity and reinforces rights such as freedom of expression (Acerbi, 2019). In the digital age, society functions as an "information society," where people navigate an overwhelming abundance of data—what Levin and Mamlok (2021) describe as "a sea of information" (2021, p. 5). Additionally, machines increasingly carry out tasks once performed by humans, diminishing the centrality of human labor and challenging anthropocentric models of culture and history. As Levin and Mamlok (2021) argue, today's culture is shaped not only by human activity but also by material artifacts. Altogether, digitalization has become a defining feature of modern society, fundamentally transforming how individuals and communities interact.

Technoscientific rationality: The zeitgeist

The ubiquity of technoscience and its indelible impact shape people's understanding in one direction (Ihde, 1990). As a result, the interaction between technoscience and humanity stipulates various new thinking, configurations, experiences and practices. In this section, I shall discuss some prominent intellectual trends and experiences in the technoscientific culture, what I prefer to call the Zeitgeist of the period.

One of the features of technoscientific rationality is the challenge to the legacy of Western philosophical thinking known as dualism. Dualism has been the center of Western philosophy and human history for centuries. For instance, the distinctions between reality and virtual, mind and body, nature and culture, human and non-human, and so forth are long-existing dichotomized entities (Koenig & Casper, 1996).

Technoscientific advancements, for instance, biotechnologies and their practices, such as frozen embryos (in vitro fertilization), genetically modified crops, tissue banks, psychotropic drugs, sensing robots, the integration of smart sensors in human life, and so forth, blurring the dichotomies between nature and nurture and human and non-human entities. The point here is, not only about the distortion of these dichotomies, but that the distortion in turn influences how and what we think about nature, religious values, moral principles, gender roles, family politics, and so forth. Moreover, it alters how we act and, in general, our relationship with the world. For instance, the extended mind thesis (EMT),

introduced by Clark and Chalmers (1998) and later expanded by Scaltsas (2018), challenges the traditional human/nature divide by proposing that cognition can extend beyond the brain to include external, non-biological objects like computers and brain implants. These technoscientific artifacts do not just aid cognitive processes, but they can become integral parts of the mind itself, forming a unified cognitive system with the brain (Clark & Chalmers, 1998). EMT thus exemplifies how technoscience blurs the boundary between human cognition and the physical environment.

Another key aspect of the technoscientific era is its role in redefining fundamental concepts such as personhood, time, space, health, and knowledge. Technoscience reshapes human identity and enables people to work and communicate globally in real time, collapsing traditional boundaries of distance and sequence (Levin & Mamlok, 2021; Du Toit, 2005). Biomedical technologies further challenge traditional notions of health and illness by altering how diseases are defined and experienced (Koenig & Casper, 1996; Clarke et al., 2003; Hofmann & Svenaeus, 2018). Additionally, the overwhelming flow of information is transforming our understanding of knowledge itself.

A defining feature of technoscientific rationality is its pursuit of control, particularly over nature, enabled through advanced innovations (Raisinghani, 2018). As Eneh (2008) argues, technoscience serves as a tool for human dominance over the Earth. While human development is often viewed through the lens of personal capabilities (Nussbaum, 2000), it increasingly depends on technoscientific capabilities, shaping not only individual growth but also global competition and power dynamics. This is evident in the geopolitical race for technoscientific superiority among nations like the U.S., China, and Russia (RT, 2017). Economically, technoscience underpins what is known as the "techno-economic paradigm," driving global production, trade, and development (Sagasti et al., 2003). Development is now largely measured in technoscientific terms, equating progress with technological capacity (Raisinghani, 2018).

This has led to the diffusionist model of development, which promotes spreading Western technoscientific achievements globally, often through institutions like the IMF and World Bank (Weiler, 2011; Pollock & Subramaniam, 2016). Agreements like TRIPS further consolidate power in technoscientifically advanced nations (Sagasti et al., 2003). Moreover, technoscience reshapes knowledge itself—from how it is produced to how it is valued. In today's world, knowledge is judged by its practicality and efficiency, reducing it to material terms (Meskus, 2015; Marcos, 2020). It is no longer an end in itself, but a tool for problem-solving. Technoscientific tools also foster new modes of learning and

knowledge sharing, such as situated learning and digital preservation (McCormick, 2004; Hawajreh & Sharabati, 2012; Ipek & Ziatdinov, 2017). As Weiler (2011) notes, the concept of knowledge has undergone a profound transformation under technoscientific influence.

Discussing the pharmakon: Technoscience as panacea and malady

As previously mentioned, while technoscience and its creations are intertwined with human existence and significantly influence contemporary society, their impact can be characterized by two distinct attributes. On one hand, they contribute positively to the enhancement of human life, while on the other hand, it they can lead to dehumanization. In this section, much emphasis will be given to illuminating how technoscience is simultaneously becoming a 'pharmakon' — both panacea and malady.

In order to uncover this point in detail, it is important to consider at least three dominant theories in the philosophy of technology, namely: instrumentalism, social constructivism, and determinism. These theories offer a basis on which to analyze the issue at hand. Instrumentalists argue that technoscientific artifacts are a mere tools or means to an end (Pitt, 2014). According to them, artifacts are shaped by the command of their designers. Hence, technoscience and its artifacts are neutral; they are not inherent means of domination or emancipation. What makes technoscientific things good or bad is, therefore, the intention of the users. Similarly, the Social Construction of Technology (SCOT), a theory developed by scholars like Bijker, Hughes, and Pinch (1987), emphasizes the role of social groups in constructing technoscientific things. According to social constructivism, artifacts are ultimately shaped by the social environment, including cultural and economic factors (Aarden, 2009). SCOT insists that technoscientific development and its change can be analyzed in relation to society instead of being seen as autonomous entities, since they are created and shaped by social actors (Bijker, 2010).

In contrast to instrumentalists and SCOT, determinists assert that technoscientific artifacts have their own autonomous logic once they are produced. It is a type of determinism claiming social progress is beyond human control. According to determinism, artifacts "form a culture of universal control; nothing escapes it, not even its makers" (Feenberg, 1999, p. 3). Accordingly, they transform the multifaceted aspects of society. In this connection, Martin Heidegger points out that technology is "neither a human activity nor a mere means within such activity" (Heidegger, 1977, p. 21). Instead, it is self-governing and determines social structure and cultural values.

While some theories attempt to define technoscience by assigning it a fixed essence, such approaches are overly simplistic and fail to capture the historical and contextual complexity of the phenomenon (Ellul & Merton, 1964).Technoscience is not static: it evolves over time and reshapes its relationship with humanity. Instead of seeing artifacts merely as tools, it is crucial to understand their deeper integration with human life. As Verbeek (2015) argues, some technologies, like brain implants, function as extensions of human beings, influencing identity and social dynamics in unintended ways, such as social media creating new, unforeseen forms of interaction. Although artifacts can shape society, they are also shaped by human values embedded in their design, which impacts people even beyond those involved in their creation.

Technoscience thus plays a dual role; it enhancing capabilities while posing ethical and sociocultural challenges. In economics, for instance, it fuels global growth but also disrupts local economies. As Birch (2019) notes, daily life is increasingly structured by technoscientific systems of production and consumption. The rise of the "techno-economic paradigm" (Sagasti et al., 2003) favors high-technology industries, marginalizing micro-businesses, distorting supply chains, influencing consumer habits, and shifting government policy priorities. This imbalance pressures local markets and erodes traditional production systems (Eneh, 2008), illustrating the double-edged nature, or pharmakon, of technoscientific development.

The advancement of technoscientific products, particularly artificial intelligence (AI), is transforming employment patterns in both positive and negative ways. AI automates routine tasks, creates new jobs, and enhances productivity, such as in medical diagnostics. However, it also reduces job security by replacing human workers in routine jobs, aligning with Marx’s view of machines alienating workers from meaningful engagement and creating unproductive labor (Wendling, 2009).

In the social and political sphere, technoscientific artifacts, especially social media, have dramatically reshaped politics. They have enabled greater citizen participation, influenced political agendas, and even assisted governments in manipulating public opinion. Social media played a crucial role in global political movements like the Arab Spring and Occupy Wall Street (Auvinen, 2011). However, while enhancing political awareness and cultural diversity, social media also spreads misinformation, fostering societal manipulation and disorder. In Ethiopia, for instance, social media has influenced the political landscape in a variety of ways. It has been an effective activism tool. During the massive protests that erupted in the country (2016-2018), notably in the Oromia region, social

media, especially Facebook, played a crucial role. Hashtags like #OromoProtests and #OromoRights trended internationally and garnered global attention to the Ethiopian government's response to the protests. It also helped activists mobilize both within the country and among the Ethiopian diaspora. The role of the Twitter campaign in Prime Minister Abiy Ahmed's rise to power was pivotal. During the Tigray Conflict (2020–2022), social media played a significant role in spreading narratives and global advocacy (#TigrayGenocide and #EndTigrayBlockade) by recording and disseminating real-time updates from the frontlines. Although Ethiopian influencers and YouTubers have been crucial in influencing public opinion, their usage as a vehicle for divisiveness and disinformation has also exacerbated tensions.

Social media platforms have fostered echo chambers that allow misinformation and radical opinions to flourish, exacerbating interethnic conflicts and enabling foreign meddling in political affairs. A notable instance is the 2016 hacking of Democratic National Committee emails by Russian agents, which had a significant effect on the U.S. presidential election. In light of this, multiple parties have initiated measures to mitigate the political repercussions of technological devices.

The integration of technoscientific gadgets in education, such as the 1:1 initiative (where students are paired with personal devices like smartphones and tablets), enhances learning opportunities and problem-solving in subjects like chemistry, physics, and engineering (Higgins & BuShell, 2018). However, excessive screen time has drawbacks, including health risks (e.g., exposure to blue light radiation) and learning deficits, such as reduced competencies in reading, writing, and arithmetic (Saunders & Vallance, 2017; Alhumaid, 2019). Furthermore, the focus on technologically driven education has dehumanized the system, turning students into commodities for profit in an economy-driven educational model (Raisinghani, 2018). This creates a divide between developed and developing countries, as students in the latter lack access to essential technological tools, limiting their future job prospects (Alhumaid, 2019). Thus, technoscience in education demonstrates its dual nature, the pharmakon, both enhancing and harming the system.

Altogether, technoscience has two facets: positive and negative. But, what does the pharmakon entail? As technoscientific things become both panacea and malady, technoscience can be perceived in two different and opposing ways by technophobes and technophiles. On the one hand, it is characterized as a glorious kind of human civilization and a reason for Western development. Channell (2017) enumerated:

> During the last 200 years, a sustained interaction between science and technology has led to a tenfold increase in per capita income, a significant decline in infant mortality, a decrease of plagues and famines, a dramatic shift in the working population away from farms and into cities, and a rise in the standard of living with new products and communication systems (Channell, 2017, p. 2).

On the other hand, the adoption of technoscientific development and artifacts adversely affects society. Particularly, it causes changes in the social structure of the recipient developing society. As Eneh (2008) contends the adoption of technoscience:

> "...could lead to increased production output with lower selling prices, the decline of small industries and loss of employment opportunities, an increase in dependency on foreign raw materials, and rural-urban migration. Thus, technology transfer contributes to the creation of a 'dual society'" (Eneh, 2008, p. 7992).

Therefore, while technoscience transforms humanity and its surroundings, the extent and intensity of its effects differ. This variation can be attributed to the distinct characteristics present in both the environment from which it emerges and the environment that receives it. Technoscience should be assessed and understood within its specific context. This means that it is essential to consider the interplay between humans and technology in a particular setting to effectively analyze technoscience and its mediating function.

Conclusion and recommendations

As previously mentioned, although technoscience can be characterized in multiple ways, it signifies a distinct relationship between science, technology, and society. It is intricately woven into the fabric of modern society, significantly influencing, if not dictating, everyday life and social frameworks. It affects nearly every aspect of human existence, ranging from political dynamics to extensive societal changes. It has redefined human identity, social relationships, and cultural frameworks. Therefore, technoscience and its associated technologies are not simply instruments but rather active participants that co-create human experiences, perceptions, and even identities, ultimately redefining the essence of humanity. This is exemplified by the emergence of new ontological realities where selfhood

is dispersed across both physical and digital realms. In a similar vein, society has evolved into a hyper-connected, information-centric network where digitization influences social life, altering its fundamental structure. Furthermore, technoscience is transforming traditional dichotomies, redefining core concepts, and affecting economic, political, and epistemological frameworks. It reconfigures our understanding of time, space, health, and knowledge, promoting a globalized and interconnected world.

Nevertheless, while technoscience exerts a significant influence in our contemporary milieu, it functions as a pharmakon—serving as a cure and a curse—simultaneously enhancing and undermining human existence. This duality is apparent across economic, political, and educational domains within the environments where technoscience is developed and applied. In other words, the effects of technoscience are context-dependent, shaped by human agency, social structures, and historical circumstances.

Recognizing the conceptual ambiguity inherent in technoscience, examining the phenomenon through interdisciplinary lenses is crucial to understand its dynamics and engage with its transformative influence. This engagement enables scholars and policymakers to critically evaluate the multifaceted aspects of technoscience and its consequences. Additionally, fostering public understanding of technoscience is vital, as it is deeply integrated into everyday life. An informed society can then establish a regulatory framework to govern and align the societal relationship with technoscience. This proactive approach can help avert the misuse, over-reliance, and dominance of technoscience by a select few nations, while also providing cultural and institutional safeguards that uphold fundamental principles, including dignity, privacy, and autonomy, against unchecked technoscientific determinism. Moreover, to investigate the dual nature of technoscience, a balanced and proactive strategy is required. Global collaboration in the realm of technoscience is essential to ensure that marginalized communities are included in technoscientific design. By advocating for equitable access to technology, we can reduce global inequalities. Therefore, by embracing a nuanced and ethically informed approach, humanity can enhance the benefits of technoscience while minimizing its potential harms.

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