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INTRODUCTION

Enhancement Technologies and the Politics of Life

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Manufacturing Life

The topic of this special section, "Manufacturing Life," goes way beyond research fields such as synthetic biology or human augmentation technologies. "Life" is both a concept and a matter of fact. What precisely constitutes "life" could—and, from our point of view, should—be understood as a feature that is allocated through social processes of (re-)configuring the social world that, in turn, claims to be the only real world. On the one hand, the differentiation of *bios* and *zoe* is an ancient one and many authors have dealt with these concepts [1–3]. On the other hand, one crucial consequence of the discussion on the politics of "life" was the urge to differentiate between *bios* (as a specific form of life) and *zoe* (as the fact of life itself) [4]. The difficulties when talking about "the politics of life itself" in terms of Foucault's [5, 6] diagnosis of biopolitics as the governmentality framework typical for modern Western societies arise from struggling with different layers of materiality. There are very different materialities in terms of factualities involved when one begins to analyze how life is managed, reshaped, reconfigured, and reinvented to be used as a framework to deal with reality as a social reality that is to reign upon. Manufacturing life, thus, goes by a broader understanding of life that includes not only the living, from the unicellular (a genetic modification for example) to the multicellular (plant, animal, human being), but also the social life with all the seemingly non-living things (robots, organizations, etc.), surrounded, (re) configured, and infiltrated by the social. The articles in this special section place emphasis on the materiality of the socio-bio-technical impact on the concept of life.

Enhancement Technologies and the Politics of Manufacturing Life

The use of diverse (bio-)technological methods and practices to overcome the "nature of the (human) being" appears to be emerging as a societal trend and may lead to a new kind of enhancement culture [7]. Following this trend, not only humans can be improved by non-human beings or artifacts, discussed as "human enhancement" in the literature, but also animals can be too, discussed as "animal enhancement" in the literature. Views and visions that humans as "deficient beings" [8] must make use of various technologies to eliminate their "deficiencies" and improve their performance are not new. Visionary universalistic conceptions of a profound transformation of the human being as well as the substantial transformation of human nature, which we already encountered to a large extent in the first half of the

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twentieth century [9], mostly remained rather vague with regard to their scientific-technical preconditions. Living beings, on the other hand, appear to be increasingly apt to be modeled, configured, and constructed in actual terms as a result of scientific-technological developments and future breakthroughs within the twenty-first century, also in response to current social challenges. "Visions of modifying animals or of creating new entities to respond to environmental challenges such as climate change, the example of Enviropigs and the in vitro meat show, are slowly gaining importance" [10] (p. 7). Human enhancement technologies are categorized into existing, emerging, and speculative technologies (such as "mind uploading"). However, the separation of existing from emergent technologies becomes increasingly blurred with technological advances. Existing technologies include, for example, reproductive (in vitro fertilization, preimplantation genetic diagnosis,), physical (doping, pacemaker, bionic lenses), and mental enhancement (cognitive enhancers such as smart drugs). Emerging technologies are mostly on the way or being tested, such as advanced genetic engineering, neurotechnological implants, nanomedicine, and 3D bioprinting.

Nevertheless, the term "enhancement" has been separated from therapeutic/medical enhancement in numerous papers. Often, the functionality and ability of the body as normal was taken as a reference:

> At first glance, the relationship might seem simple: enhancement is the gain of function, disability is the loss of function. One relates to something above normal functioning and the other below, like mirror images with the level of normality as their axis of reflection [11] (p. 2).

And Rehmann-Sutter and colleagues continue:

> [E]nhancement is what brings the human body beyond normal functioning, whereas repair and therapy bring it back to normal. In this sense, prostheses or disability aids should imitate a normal embodied function, replacing the natural limb or sense with an artificial device. Even though they may enhance the shape and function of an individual's impaired body, they are therefore not enhancements (ibid. p. 5).

Enhancement technologies are almost inextricably linked to the functional status of the living being, and, as such, the health status and medical innovation. Research in disability studies has shown that the distinction between normal and disabled, for example, leads to confusion. Of importance here is the historical examination of the development of modern medicine and its institutionalization as well as the distinction between "healthy" and "sick." Other historical works that describe being healthy as both a normal and normative state [12] are also relevant to the sociology of medicine. So are approaches at the intersections of medicine, normalization, and mechanization, which emphasize that the mechanizations of medical action, as well as technomedical innovations that are intimately intertwined with the human body, make the state of health socially desirable and socially acceptable by helping to bring the "normal state" to a new level through preventive or performance-enhancing measures [7, 13]. It is even stated with regard to prosthesis developments from 3D-printed prostheses to bionic prostheses that "normality" is not aimed at and becomes obsolete for various reasons and that the addressing of "normality" is replaced by addressing "human enhancement." The cyborg body becoming a habit would eventually lead to the loss of meaning of current normality and favor human enhancement [14]. This argument makes sense if one looks into recent discussions within disability posthuman studies [15] or crip technoscience [16]. People with disabilities are called upon to make and hack themselves, a kind of self-empowerment via assistive technologies. Hamraie and Fritsch [16] underline the power of activism and active technology modification as "hacking and tinkering practices" in order to transform assistive technologies into "politics of interdependence":

> While the movement was critical of rehabilitation as a field of expert knowledge, it did not refuse the language or tools of rehabilitation outright. In addition to appropriating the term Independent Living to promote a disability politics of interdependence, the movement understood technoscience as a site of politicized resistance and regularly used hacking and tinkering practices as the basis of disability organizing (ibid. 2019, p. 12).

Rethinking assistive technologies undoubtedly lead to understanding these technologies not from a technologically fixed narrative developed from the outside, by third parties, but rather one that actively shapes a concerned person in all its cultural, political, and self-empowering individual dimensions.

The idea of a manifesto advocating self-empowerment is not a recent one. With technologies such as RFID, a bio- and body hacking movement emerged [17–19]. At the same time, discussions started about the differences between post- and transhumanism. About 10 years ago, two special issues of the *Journal of Evolution and Technology* (2009, 2010) dealt with this topic. Transhumanism was understood as a sub-category, a specification, of the much more general and vast topic of posthumanism. Whereas posthumanism questions the modern belief that "homo sapiens" is categorically different and as such superior to any other living being, and thus disputes the border between life and death (and the inherent hierarchy between them), transhumanism focuses on such developments as cyborgism, the linkage between technology (in its mere materiality) and humans, designed to overcome (natural) shortcomings, and, in doing so, surpassing biological "restrictions." Transhumanism can be discussed in a critical, reflexive manner—yet, in the literature one often comes across a somewhat naïve understanding of nature (as the pure biological outcomes) and technology (as a form of culture); the combination of the two leads humanity somewhere different, and, hopefully, to a better future. Even if it is sometimes hard to draw a clear line between the two, posthumanism is first and foremost a reconstructive critical perspective on (predominantly) modern Western culture that particularly highlights hierarchies (between humans, humans and animals, living beings and inorganic matter, etc., pp.).

In the special section, some articles address the benefits of combining humans and technology—as if they were really two distinctly different matters, contrary to the notion that humans living in modern societies already are cyborgs, or, in Haraway's words, that "the cyborg is our ontology" [20]. On the other hand, you will find contributions questioning this distinction as a socially created version of reality and discussing how this distinction is deepened, reconstructed, and sometimes weakened through socio-technological arrangements, as well as the possible consequences of these dynamics for contemporary or future societies.

Consequences of Manufacturing Life

Existing and emerging technologies for (social) life already influence and shape science and society [21]. Manufacturing life by means of science and technology raises questions about nature and technology, as well as about, for example, the "normal," "standard," "truth," or "real." It produces everyday problems such as drug resistance, renaturalized organisms, chimera, bionic body parts, and designer babies, causing specific vulnerabilities [22] that create the need for specific socio-bio-technical care [23]. With that, also the opposites appear, for example the "enhanced," "artificial," "monstrous," and "faked." In the end, we wonder what we are dealing with: nature or culture [24]. However, this dichotomous way of thinking has become obsolete since the first cyborg studies. We now understand that the social relation to nature is not determined by an opposition between culture and technology or society and nature. Its constitution results from an interrelation.

The special section gathers research results and insights about the (re-)constructions of living beings through practices in life sciences and technology, with a focus on cultural, ethical, and social issues related to nano-, bio-, information, and cognitive sciences and technologies. One reason for focusing on these topics is the assumption that the convergence of these fields will lead to a substantial transformation of the corporeality of living beings, their relations with one another, technology, and society. Human pathways not only are bound up with other species, such as microbes, plants, and animals, but they are also bound up with technology. However, in Western contemporary civilization, technology is construed as something "opposite" of human beings who are designated as "natural" entities. Relying on nature and culture as extreme, opposing reference points is a necessary premise for most inequality-related oppositions (e.g., relying on nature often legitimizes discrimination as a "given fact"). However, enhancement practices (including "plant enhancement," "animal enhancement," or "human enhancement" through, e.g., brain-machine interfaces, genome editing, and prosthetics) are already manufacturing life in various ways, using different enhancement technologies, combining them (both living beings and technologies) in different environments, creating new entities, such as organic–inorganic and human-nonhuman entanglements, similar to cyborgs or human-animal chimera, and (other) new socio-technical systems. Some guiding questions of this special section are as follows: How will these practices affect the abovementioned human-technology opposition? What will be the

consequences for contemporary Western culture that is built on the pillars of humanism and a dualistic, Cartesian approach? What other intersections and practices without this dualistic view can be observed and to what extent are they undermining regimes of injustice that are relying on the social construction of nature and culture as distinct, separate areas of knowledge and influence?

The Contributions to the Special Section

In the special section, Vallès-Peris, Argudo-Portal, and Domènech look at how the concept of life plays an important role in ethical arguments around medical technologies where life is being manufactured as a result of the tensions and conflicts that arise when such technologies are used. Introducing two research projects, one dealing with biobanks and the other with social care robots, they explore from bioethics and STS perspectives how ethical discussions in these projects implicate particular concepts of life. They argue that the contemporary epistemic category of life is a manufactured life, in which different rationalities coexist: one rationality being based on the separation between the technological and the human, focusing on pragmatism and functionalities and tend towards a dualized concept of life divided into qualified and non-qualified life. The other rationality is based on a non-essentialist ontology and focuses on the mediating role of health technologies that entails a distributed life.

In his discussion note, Rasper emphasizes the importance of paying attention to neural engineering's cultural practices of manufacturing life in life sciences. He points to instances of onto-epistemological violence that shapes the life of disabled people. A possibility of intersectional-cryriarchal understanding of interlocking systems of privilege and oppression as well as productive collaborative work arises from a critical perspective of crip technoscience: criptical neural engineering is addressing disability equity and disability advancement. It focuses on disabled people as epistemic activists and demands responsiveness and accountability from non-disabled people.

Butnaru's paper draws on a qualitative study including ethnographic visits in laboratories as well as expert and narrative interviews. From the perspective of phenomenology and disability studies, she points out that technological possibilities of body modification such as exoskeletons influence not only the way we perceive our bodies, but also how we delegate abilities to machines when our "natural" body lacks them. She argues that, while the challenge posed by these new technologies is that they develop new notions of what our bodies can and cannot do, being temporarily disabled configures, at the same time, the conflicts inherent in these processes and the possibilities they concretely open up.

In their article, Ochsner, Spöhrer, and Stock discuss how mobile technologies mediate between heterogeneous environments and sensing beings. They focus on the manufacturing of the human sensory system to critically reflect on the concept of assistive technologies, which are perceived as tangible solution-bringing artifacts for a specific disability, and question the conventional distinction between user and environment, arguing for a more nuanced view. The authors present results of two case studies in which they explored the relationships between emerging "assistive" app technologies and human sensory perception: a hearing aid that allows for direct connect with Apple products, and an IOS app for sonic wayfinding for blind people. They highlight the significance of dis-/abling practices for manufacturing novel forms of hearing and seeing, drawing on sources like promotional materials by manufacturers, ads, user testimonials, and reviews and providing crucial insights into the contemporary entanglement of algorithm-driven technologies, daily practices, and sensing subjects—the production of techno-sensory arrangements.

Scheermesser's contribution to the special section investigates how non-human actors influence the acceptability of new technologies, using the example of actibelt®, a digital wearable in the shape of a belt measuring and recording movement data of people with multiple sclerosis (MS) in order to make statements about movement quality. Scheermesser identifies forms of non-human actor acceptance work and their impacts on patients. According to her, non-human actors are passive actors in the construction of technology, as the various modalities of acceptance work demonstrate, but enable, hinder, or condition acceptability. Non-human actors thus play an important and integral role in translation processes. From a crip technoscience perspective, Scheermesser argues in favor of taking the needs of people with MS as the starting point of technology development, rather than problem solutions or technology-driven ideas.

From a multi-species point of view, Kubes and Reinhardt discuss how the value of life for humans may change if the species are not merely living beings anymore but highly intelligent artificial robots. They raise the question of the entanglement between species which challenges a preconception that in modernity is taken for granted. However, this assumption is achieved by modern sciences themselves insofar the hybridity of the own constitution of *Homo sapiens* is made invisible. Furthermore, they argue that future robots will be a (completely artificial) new species. In doing so, the authors question a fundamental pillar of modern Western culture, namely the categorical distinction between nature and culture. Arguing for a "relational ontology of multi-species assemblages" (ROMA), the article is an important contribution to the debates about robotics, artificial intelligence, and posthumanism.

In their critical evaluation of the cognitive enhancement topic in the context of performance in the workplace, Acartürk and Mücen question the changes that an increased use of more capable artificial intelligence might have on the work environment in general, and on the human workforce specifically. They suggest that the cognitive performance of human workers, measured by the artificial intelligence in place, will replace the usual time measurement.

Moniz and Krings look for answers regarding the boundaries between work, interaction, humans, and life from a specific work-oriented perspective on human–robot interaction. They argue that a shift in the use of robotics within work environments changes not only the nature of the work but also the personality of humans and the character of life itself. The authors conclude that the boundaries between these entities are getting blurred and even vanish in human–robot interactions. The authors argue for safety standards and questions of worker autonomy to be re-evaluated and critically assessed.

Last but at no means least, Lipp and Maasen introduce two distinct empirical fields to address pertinent questions arising in the reconfiguration of societal contexts: social robots and brain–computer interfaces. Their theoretical framework derives from Karen Barad's agential realism. The authors apply the concept of interfacing in order to examine how human life and technological materiality produce one another by interconnecting. Using these theoretical tools, they show how the process of interfacing is never a neutral one. Lipp and Maasen thus provide an impressive analytical framework to evaluate and assess human–technology (re-)configurations.

Furthermore, this collection of articles on the topic of manufacturing life includes various contributions at the interfaces of art and science. As the second part of the special section, they will be integrated in the next issue of this journal.

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