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Cognitive artifacts and human enhancement

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ABSTRACT: Human improvement is epistemologically challenging and has awakened a wide range of academic and public debates, especially considering the possible ethical and political consequences of its regulation. This article focuses on a selection of conceptual questions about cognitive enhancement and defends, through the discussion, the role of cognitive artifacts and the insufficiency of a strictly materialistic vision of enhancement techniques. The article approaches 3 specific questions: first, that the concept of enhancement should not be linked only with biotechnological artifacts; second, that the most potent technologies of the near future will be those that offer user integration and transformation with machines without the need for implants or surgery; and third, that cognitive artifacts, i.e. non-biological material devices coupled to cognitive system functions, are responsible for the course of human enhancement throughout history. Thus, we do not need a moral compass to evaluate all dimensions and risks that human enhancement can elicit, since traditional conservatism about enhancement limits itself to the idea that the growth of our powers would make our values unsustainable and put the current way of human life at risk.

KEY WORDS: Human enhancement · Cognitive artifacts · Extended cognition · Biotechnologies · Existential risks

1. INTRODUCTION

The Bajau community residing in Southeast Asia, within the maritime expanses of the Philippines, Malaysia, and Indonesia, is often referred to as sea nomads or maritime wanderers (or sea gypsies). Their survival is entirely intertwined with the ocean, as they have been navigating local vessels for over a millennium. As such, these aquatic foragers are reliant on the sustenance they gather via free diving, and their exceptional aptitude for plunging to depths exceeding 70 m with just weights and rudimentary wooden goggles is renowned (Perruzo Júnior 2022). Consequently, the Bajau populace spends 60% of their daily labor submerged underwater, upholding a lifestyle rooted in various cultural elements and technological innovations, and as highlighted more recently by Ilardo et. al (2018), also in physiological adaptations to diving and hypoxia tolerance.

Their study thus demonstrated a genetic relationship between spleen size and diving ability, as 2-plane ultrasound measurements to calculate spleen volume indicated a significant visual difference when Bajau divers were compared to Bajau non-divers (Welch 2-sample *t*-test, $p < 0.0001$). Moreover, indications of robust selection in the BDKRB2 gene, which impacts the human diving reflex, have been observed (Perruzo Júnior 2022). Assuming that were true, would we be facing a type of permissive and natural human enhancement as described by Agar (2013) when discussing the tension between enhancement and survival? Or could it be that the conceptions of naturalness would be sufficiently capable of providing resources to establish boundaries for human enhancement and avoid genetic, biomedical, or pharmaceutical interventions without therapeutical purposes? The answer to such questions, as we have argued (Peruzzo Júnior 2022), needs to ana-

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lyze the role of non-invasive artifacts, their influence on human abilities and, consequently, the idea of natural and therapeutic enhancement, as well as possible ethical barriers.

Persson & Savulescu (2017, p. 16) state that 'our knowledge of human biology, in particular of genetics and neurobiology, is starting to provide ways of affecting directly the biological or physiological bases of human motivation'. The authors say that 'humanity's situation is critical, since human beings now have the means to undermine the conditions of dignified life on Earth *forever*' (p. 16). However, should we talk about invasive devices and new bioengineering techniques to comprehend the advances of human enhancement through history? Should we limit the expansion of scientific knowledge and technological expertise because of the risk that a single person 'with relevant training could extinguish all higher life forms on Earth' (Persson & Savulescu 2017, p. 78)?

Regarding the principle of precaution (which suggests that all dangers should be considered likelier and as having bigger magnitude than benefits[1]), John Harris (2010) argues that, unless the future progress of humanity in a scenario with enhancements could be compared with its unimproved counterpart, it would be impossible to identify the best option. That is why, according to Harris (2010), in the absence of reliable knowledge about how dangerous things can become with human intervention, there is no rational basis for a preventive approach that prioritizes the status quo. Kelly (2010) has an even more radical understanding of this principle because, considering that every good deed would produce some evil, no technology should be allowed. '[…]. As a practical matter we are unable to address all risks, regardless of their low probability' (Kelly 2010, p. 213). Kelly (2010) also explains that, if pushed to the limit, such precaution would end up favoring a single value—safety—to the detriment of all the potential benefits that innovation would likely bring, which would therefore lead to a myopic and conservative world[1].

We argue, throughout this article, that cognitive artifacts, i.e. non-biological material devices coupled with cognitive system functions or with the body, were and still are responsible for the course of human enhancement throughout history. Therefore, we do not need a moral compass to evaluate all dimensions and risks that the human enhancement theme may elicit, since the traditional conservatism about enhancement limits itself to the idea that our powers of action and growth due to the interventions of scientific technology would make our values unsustainable and put our current way of life at risk. This reading is partially true. As Fukuyama (1992) has written, technology makes unlimited accumulation of wealth possible, with the consequent satisfaction of a set of human desires in constant expansion, which could increase the problems caused by environmental damage and consumerist frivolity. Therefore, the modification of our nature would only be the result of a drive for domination—which, if carried out, would compromise the ethical sense of humanity.

Thus, a bioconservative reading of human improvement could indicate, as Fukuyama (1992) maintains, that variation among individuals is distributed in the population according to a normal curve—and this curve is the product of heredity, i.e. of nature itself; therefore, using biotechnology to alter it would destroy the foundation on which human dignity rests. It is here that a philosophical analysis of human enhancement can indicate a function dissociated from the strictly biological position, allowing us to disengage from moral pretensions in order to understand cognitive artifacts.

2. IMPROVING THE CONCEPT OF HUMAN ENHANCEMENT

The catastrophic pessimism about human enhancement could also reveal that the reduction of aggressiveness, a behavior that is a hallmark of xenophobic, illiberal, and undemocratic systems, would be obliterated as growing technological expansion reveals the importance of multiculturalism. The enhancement of certain virtues such as empathy and respect for diversity, for example, could indicate a type of enhancement derived from rarely seen strategies regarding a direct impact integrated with the body, unlike the topics discussed by Harris (1992) and Bostrom (2014). This, obviously, does not depend only on coupling biotechnological artifacts with the individual. Therefore, evoking worst-case scenarios to support a conservative reading about human nature is, at best,

[1]'[...] the Precautionary Principle is biased against anything new. Many established technologies and 'natural' processes have unexamined faults as great as those of any new technology. But the Precautionary Principle establishes a drastically elevated threshold for things that are new. In effect, it grandfathers in the risks of the old, or the 'natural.' A few examples: Crops raised without the shield of pesticides generate more of their own natural pesticides to combat insects, but these indigenous toxins are not subject to the Precautionary Principle because they aren't 'new.' The risks of new plastic water pipes are not compared with the risks of old metal pipes. The risks of DDT are not put in context with the old risks of dying of malaria' (Kelly 2010, p. 215)

equal to the same reading that advocates ideological neutrality to justify any and all forms of improvement.

Thus, the internal problem of human enhancement is, on the one hand, the possibility of clearly marking the natural incorporation of cognitive artifacts and, on the other hand, an intentional lack of control over biotechnological mechanisms which, by being artificial, could act on a natural locus that should be preserved. Generally, the absurdity of this hypothesis manifests in the strategy that medicalization could bring us closer to perfection and, consequently, free us from disability. For instance, Tom Shakespeare (2014, p. viii) argues that 'in face of the difficulties of disability, the traditional answer was medicalization. If those difficult conditions could be healed or avoided (…) these poor souls would be in a better situation'. According to him, medicalization is not a definitive answer to the debate about human enhancement, and often is not the most appropriate and cost-effective answer. So, Shakespeare (2014, p. ix) concludes that 'we are on the verge of a future where we are promised transformations in human incarnation as profound as the transformations of science, manufacturing, communications, travel and understanding that emerged in the last century'. However, it is impossible to know for sure whether that is a sober prediction or science fiction.

Obviously, as described by Shakespeare, when the subject is the prediction of the future, fantasies are not a reliable guide. In this sense, Mirian Eilers, Katrin Grüber, and Christoph Rehmann-Sutter argue that the power of changing the human condition for the better by building fitter bodies cannot be reduced to a simple matter of good and evil, since that would be deeply ambivalent. For them, 'it may seem to be an irresistible power, sometimes even morally tempting, apparently in the pursuit of good, but it is also fraught with arrogance and produces many parallel disadvantages' (Eilers et al. 2014, p. 1). Hence, an important question is raised: in order to capture the intricacies of enhancement thinking, we need to distinguish the different directions of improvement and, from there, if there is a common project of human enhancement or, on the contrary, strategies that simply merge fiction and fascination.

Hauskeller (2013) points out that it is necessary to distinguish different enhancement directions: on the one hand, directions that would make us more intelligent and morally better, making us feel better and truly human, especially by providing a better and stronger appearance, compensating for natural fragility; on the other, the currently possible interventions, such as body shape enhancement, smart prostheses, artificial limbs, mechanical exoskeletons, implanted hearing aids, or smart electronic brain implants to improve mental performance. However, this concern is only related to what human enhancement would represent in a possible disturbance of the delicate balance of nature, resulting in non-intentional, but potentially disastrous, damage. In summary, Hauskeller (2013) underscores the need to differentiate between various enhancement directions, encompassing both intellectual and moral improvements as well as physical enhancements. These advancements could evoke a more profound sense of humanity.

Beyond the field of biotechnology, Raisamo et al. (2019) prefer the term human augmentation over human enhancement, since augmentation is already the most common term in the interdisciplinary research community focused on interactive digital extensions of human abilities. On the other hand, Raisamo et al. (2019) admit that using human augmentation instead of human enhancement would represent a non-trivial employment of the term in the context of human–technology interactions. Be that as it may, what is interesting in the approach of Raisamo et al. (2019) is the definition by which human augmentation would correspond to the area of study focused on methods, technologies, and their applications to enhance the sensory, action, and/or cognitive abilities of a human being. This would be achieved through sensing technologies, information fusion and fission, and artificial intelligence methods. According to Raisamo et al. (2019), human augmentation could also be broken down into 3 main categories: (1) augmented senses (achievable by interpreting multisensory information, including augmented vision, hearing, touch, smell, and taste); (2) augmented action (achieved by sensing human actions, which would be subsequently mapped and transferred to local, remote, or virtual environments, creating subclasses such as eye-tracking controls, teleoperation, remote presence, and others); and (3) augmented cognition (acquired by the perception of human cognitive states with analytical tools that would interpret those cognitive processes according to the user's needs, as in the example of providing current and predictive information, either stored or recorded, during natural interactions).

Specifically regarding augmented cognition, Raisamo et al. (2019) argue that a long-term goal in the interaction of humans and technology would be the ability to use human cognition knowledge to build machines capable of thinking like humans, i.e. a kind of 'hybrid-aggregate intelligence' that could take cognition to unknown frontiers. This would be possible using a data structuring model that combines human cognition with machine learning, or with software and hardware structures that mimic the functioning of the brain, to improve the safety, reliability, and predictability of complex dynamic decision-making systems. For Raisamo et al. (2019), such systems would have the advantage of replicating human thinking and thus be able to actually expand cognition. Regarding ethical issues, the authors assert that there could be unintended consequences if the potential negative effects of such technologies were neglected, highlighting, among others, loss of privacy by allowing collection of information directly from the brain; manipulation, subtle and almost impossible to detect and suppress, if false visual and auditory information were fabricated; and unequal access to technologies, allowing certain people to have access to increased abilities (sense, action, cognition) while other groups would be excluded from similar benefits.

In conclusion, Raisamo et al. (2019) provide a comprehensive perspective on human augmentation, exploring its categories and potential implications. The preference for the term human augmentation over human enhancement reflects an emphasis on enhancing human capabilities through technology. While the optimistic view of developing a hybrid-aggregate intelligence is intriguing, it is important to acknowledge that achieving such a level of human cognitive replication is a complex and challenging endeavor. The suggestion that systems capable of replicating human thought could expand cognition presents an ambitious vision that requires further critical and cautious examinations. Additionally, the warnings about ethical concerns and inequalities that may arise with human augmentation underscore the importance of carefully considering potential negative impacts and ensuring that these technologies are developed and implemented ethically and equitably, for the benefit of society as a whole.

Indeed, while discussing technological artifacts from artificial intelligence, Mueller et al. (2020) point out that it will not be possible to think only in terms of interaction between users and devices when designing the future of computing, making it necessary to face the challenges and opportunities of integration between such users and devices. This topic will be analyzed later in Section 3. For Mueller et al. (2020), the study of integration would be essential to understand how user and technology form an intimately coupled system within an extended physical, digital, and social context, which could be called Human-Computer Integration (Hint), so that the main question would not ask how we interact with computers, but rather, how humans and computers integrate. Therefore, according to the researchers, examples such as advances in epidermal electronics and interactive textiles show that the integration of technological artifacts with the body would simply require rethinking how such devices are deployed, maintained, and connected with their surroundings. Moreover, the variety of such devices, which include technologies that are implanted deep in the body or those inserted in the body only for a specific period, show that biocompatibility becomes a challenge because it directly affects the perception of self and body design, physical and mental health, potential cultural differences, and inequality of access, often referred to as the digital divide.

Mueller et al. (2020) emphasize that the traditional approach to interaction between users and devices is insufficient to shape the future of computing. Instead, they underscore the importance of comprehending the deep integration between humans and technology. This perspective has the potential to fundamentally transform the way we conceive and utilize technology. The implications of these ideas are broad and encompass various dimensions. The focus on integration between humans and technology can lead to revolutionary advancements in how we interact with technological devices and systems. However, complex and interconnected challenges will also arise that need to be addressed. The necessary reevaluation of deploying, maintaining, and connecting technological devices to the human body brings forth ethical questions and significant practical considerations. Additionally, the diversity of devices underscores the importance of biocompatibility and raises concerns related to self-perception, mental and physical health, cultural differences, and access equity.

This approach also challenges the conventional interaction paradigm and highlights the need to understand the intrinsic interconnection between humans and technology. The implications for society, health, equality, and privacy are profound and need to be carefully explored as we move towards an increasingly technological and integrated world. Human-computer integration is not confined to technological issues alone; it also encompasses cultural, social, and ethical aspects that demand thorough evaluation.

In the past decades, several authors (Tomasini 2007, Bostrom & Savulescu 2009, de Melo-Martín 2010, Rosoff 2012, Agar 2013, Douglas 2013, Rembold 2014, Giubilini & Sanyal 2015, Danaher 2016, Kudlek 2021) have argued that society should not permanently improve humans, since this would change our common understanding of human excellency and harm our social and existential practices. However, do we really need to adopt imaginary and/or futuristic scenarios to support the debate about human enhancement? A strictly materialistic approach to enhancement can substantiate a single idea of disability and normality, but cannot bring to the debate the use and impact of cognitive artifacts throughout human evolutionary history and the consequent skepticism related to the promise of enhancement technologies. This is why, alternatively, as Hofmann (2017) states, we need to analyze whether speaking of enhancement means that individuals would be removed from the human species, so-called 'posthumans', or, on the contrary, if enhancement would be seen as part of natural history itself, as we have been molded from an adaptive integration with the environment and with a wide range of technologies and supports, many of which are invasive only at a cognitive level, such as writing, customs, and values.

3. EXTENDED COGNITION AND COGNITIVE ENHANCEMENT

For Andy Clark (2003, p. 4), the process of extended cognition can be proven through certain 'cognitive fossil traits'. At first, this would mean the use of language and counting, evolving to writing and the use of numerals, and later to the first forms of printed record. In recent times, this represents digital codifications of text, sound, and image in widely uniform and transmissible formats, currently perfected by computers, software, and professional and personal apps in such way that, as pointed out by Clark (2003), the mind of human beings is less and less inside their heads. Moreover, for Clark (2003), human beings were designed by nature with a profound neural plasticity, whose main characteristic is the ability for fusions and expansions of mind.

Ridley (2014), on the other hand, highlights that collective and cumulative intelligence is the element that separates human beings from other primates. For example, according to Ridley (2014), the extinct Neanderthals would have had huge brains, a complex language, and a lot of technology. However, they never broke out of their niche because, unlike *Homo sapiens*, they never participated in a collective process of knowledge construction.

If that was not enough, Katherine Hayles (1999) states that *Homo sapiens* engages every day in systems in which total cognitive capacity far exceeds the knowledge of a single individual. Examples are electronic car ignition systems, computerized microwaves with self-adjusting power levels, and clocks that automatically correct the time via radio waves, as well as the technological artifacts of artificial intelligence. For Hayles (1999), the primacy of a sociocultural cognitive system would show that 'modern humans are capable of greater cognitive sophistication than cavemen, not because they are smarter [...] but because they have built smarter environments in which to work[1]' (Hayles 1999, p. 289).

This is the reason Clark (2003) asserts that the most potent technologies of the near future are those that offer user integration and transformation with machines without the need for implants or surgeries. An example is the European Airbus case, in which, according to Clark (2003), the computer would help the resolution of several problems that were previously the exclusive domain of humans. Therefore, any pilot incompetence with the stick would not matter, because this airplane model would never have the nose up at an angle greater than thirty degrees. 'Flying a modern commercial plane is clearly a task in which human bodies and brains act like elements in a wide, fluidly integrated, problem-solving biotechnological matrix' (Clark 2003, p. 25).

In this context, it is important to reinforce the promises from NBIC (nanotechnology, biotechnology, information technology, cognitive science) technologies because advances in nanotechnology (blurring the boundaries between natural and artificial molecular systems), information sciences (generating smart and autonomous machines), biosciences and life sciences (extending human life through genomics), and cognitive and neural sciences (creating artificial neural networks and decoding the functioning of the brain) may change human beings in the same way that language changed the course of the species 100 000 generations ago. For Clark (2003), recent technologies allow the fusion of man and machine without the need for surgical incisions or implants, since such technologies, even if not penetrating, have sufficient power to transform human life, projects, and the sense of ability itself in a deep biotechnological symbiosis.

It is specifically at this point that we need to note a significant difference between our reading and the conservative one, which insists on defining human enhancement as associated with the use of technologies that are directly invasive to the body. The term 'invasive' seems to carry a number of problems: on the one hand, let us consider a patient who has had a pacemaker implanted in his body. No one will claim it is not invasive because its function, now internal to the body, is to regulate heartbeats and thus prolong the patient's life by improving some of his physical functions. On the other hand, let us also consider that this patient has undergone, over several years, academic training in one of the best universities in the world. He is now able to solve complex mathematical calculations, create electronic devices, and is perfectly capable of producing and sharing relevant information with other agents in his group. The information that this patient has received over the years is as invasive as the pacemaker because it allowed the cognitive enhancement of a number of skills and functions that may give him advantages over other individuals. Therefore, we need to note that the common use of the terms 'invasive artifacts' or 'invasive technologies' is much broader and more extensive than it seems at first.

4. DO NON-INVASIVE ARTIFACTS ALSO AFFECT THE IDEA OF HUMAN ENHANCEMENT?

When the weight of biotechnological artifacts on human enhancement is reduced, as proposed by Clark (2003), the first consequence is the reorientation of the tendency to visualize a border between natural and artificial, therapeutic and aesthetic, normality and artificiality, body and environment. There is no ethical violence over what is natural, since the history of human development is intrinsically linked to the improvement of its own capabilities, whether on a physiological, cognitive, or moral level. Enhancing, as such, does not mean moving towards future perfection, but being capable of comprehending that there is no moral difference between using brain circuit implants to improve memory capacity and the utilization of social rules to promote a more peaceful social organization.

Trijsje Franssen (2014) argues, for example, that one of the most important questions in the ethical discussion about human enhancement is whether it would be acceptable. This, however, while intending to move away from the arguments of Harris (2010), is unable to separate the moral evaluation plane from the attempt to conceive improvement techniques as emergent processes that stem from the progress of biotechnologies. As such, the mistake of these arguments is that they work with vague concepts of values such as happiness, well-being, kindness, and capabilities/disabilities, among others. Although they are vague, it seems that there is a tendency in literature to define that the goal of human life should be considered in terms of what is bigger, stronger, quicker, smarter, or even more resilient.

Non-invasive artifacts, therefore, affect the idea of human enhancement because they are intrinsically linked to conceptual and cognitive development. This means that, under certain conditions, the organism is closely linked to entities and external processes which fundamentally modify several cognitive competences. Clark (2003) claims, for example, that human beings are innate cyborgs because they are born with the competence to attach non-biological artifacts to their mind-bodies. In this sense, it is only possible to define the acceptance or refusal of certain techniques as long as we evaluate the interest of the terms that legitimize them. Without that, unfortunately, the argument that the fusion between men and machines depends on incisions or surgical implants would be the only one, without the realization that technological symbiosis is a constant process whose aggregation has happened since the evolution of language, the integration of mathematics, the need for political abstraction as a way of cohesion and social organization, and pedagogical efforts through educational processes, among others. Thus, the possibility of achieving above-average cognition, as stated by Pompermayer et al. (2021) when analyzing the state of scientific research about cognitive enhancement, seems to collide with the absence of mechanisms that can abstractly assess better cognitive performance, or, otherwise, to disregard a complex analysis of the situation of each individual. Manipulating and introducing modifications, therefore, are not synonymous expressions whose history begins with the recent advent of invasive biotechnological devices. We are intrinsically born coupled with the environment and have a plethora of involuntary 'enhancements' whose functions have been and will continue to be in constant change.

5. CONCLUSION

While the human enhancement debate has received significant attention in recent decades, its epistemological and ethical bases are still challenging, especially because they directly affect how we should consider our capacities and, consequently, the function of biotechnological devices and cognitive artifacts. Therefore, it is not enough to distinguish between conventional and non-conventional, therapeutic and non-therapeutic, or invasive and non-invasive interventions, as if only physical and biological limitations could be directly improved and enhanced. We should consider the very course of human enhancement throughout history which, although difficult to measure, has been responsible for structural cognitive changes that are at a barely visible border regarding physiology or anatomy. As we have tried to show, the enhancement of technological artifacts into the body goes far beyond an invasive perspective because our physical and cognitive processes have always been, in a sense, coupled with the environment.

In addition, the apparent rejection of novelty in human beings should also be considered. As shown by cognitive psychologist Daniel Levitin (2014), resistance to new procedures had already been identified more than 5 thousand years ago with the emergence of writing: '[...] many contemporaries saw it as technology that had gone too far, a demonic invention that would rot the mind and needed to be stopped' (Levintin 2014, p. 38). In the Middle Ages, after the invention of the printing press, as Levintin (2014) argues, philosophers such as Erasmus, Leibniz, and Descartes would have been opposed to books, suggesting that these publications represented an obstacle to learning, as people would stop talking to each other and having authentic ideas, which would cause a return to barbarism. In the last century, Kaku (2018, p. 209) reports that the telephone was criticized because it would be '[...] unnatural to speak to some invisible, disembodied voice in the ether, rather than talking to people face-to-face, and we would spend too much time on the phone rather than talking to our children and close friends'.

As such, both bioconservatives and liberals should present their assumptions about ideas of perfection, natural talent or capabilities, and disabilities, as well as the use of the very concept of invasive. If that does not happen, both the bioconservative and liberal stances become ubiquitous and unsustainable regarding the use or refusal of perfectional assumptions and biotechnologies of improvement. Reflecting on the non-invasive cognitive functions of artifacts, as well as the supposedly invasive ones, is a heuristic way to assess existential risks because, according to Agar (2013, p. 17), 'the philosophical task would be straightforward if we had merely to decide which of the objective or anthropocentric ideals was correct'. In terms of cognitive artifacts and human enhancement, it seems the wisest thing is to conclude that the big questions are still pending further elaboration.

The discussion about human enhancement involves complex epistemological, ethical, and cultural dimensions that extended beyond the mere consideration of invasiveness, encompassing the deep interplay between technology and society. In the debates between bioconservatives and liberals, it becomes imperative to carefully examine assumptions related to human capacities and the concept of invasiveness. Therefore, the exploration of non-invasive cognitive functions and their implications suggests that broader philosophical questions remain open.

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