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PHILOSOPHICAL & BIOETHICAL BOUNDARIES IN CURRENT BIOTECHNOLOGIES: HUMAN ENHANCEMENT AND WELFARE BIOLOGY

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ABSTRACT

The aim of this paper is to conduct a descriptive and normative exploration of the most intriguing current biotechnologies. Firstly, biotechnological means capable of enhancing humans will be described, including the possibility of transferring the mind to a non-biological device. Secondly, the emerging discipline of welfare biology will be explored, subjecting it to a theoretical stress test. Well-founded concerns regarding the potential impact of biotechnologies exist, with a particular emphasis on the speculative nature of mind uploading. In contrast to large-scale welfare biology, small-scale welfare biology seems entirely plausible to reduce wild animal suffering.

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1. Technosciences

Theory and practice converge in technosciences. By 'technique,' we refer to the set of skills that enable the use of various types of means. By 'means,' we mean the collection of machines, tools, and artifacts created by human ingenuity. Lastly, 'technology' refers to the economic, social, and labor organization of means, techniques, and knowledge within a complex structure. This triple helix model enables the development of technosciences and is prominently manifested in the so-called Industry 4.0. Industry 4.0 demands new knowledge and skills to address the technological challenges posed by the Fourth Industrial Revolution (Mababu-Mukiur, 2022). Within this digital transformation scenario, technosciences have an applied dimension concerning human beings. Humans represent a potential arena for transformation and enhancement, "information technology, genetics, nanotechnology, cybernetics and biotechnology all offer the possibility of greatly improving our human existence" (Capone & Albert-Márquez, 2022)

Álvarez-Díaz (2023, p. 6) distinguishes two major groups depending on the type of enhancement sought:

i. First, we have the modification of the human being through biotechnological means, i.e., the alteration of biology through technology to enhance capabilities, eradicate disease, and even avoid death.
ii. Second, the use of technology through technobiological means, eventually dispensing with the biological body to transfer the mind into a robot or digital substrate.

2. Editing minds

Cognitive enhancement can be defined "as the amplification or extension of core capacities of the mind, using augmentation or improvements of our information processing systems" (Sandberg, 2011, p. 71). Let's consider the medical utility of a brain-computer interface to address cognitive, sensory, or motor limitations (Shih, Krusienski & Wolpaw, 2012). However, this intervention can be carried out without any therapeutic purpose, "a cognitively enhanced person, rather, is somebody who has benefited from an intervention that improves the performance of some cognitive subsystem without correcting some specific, identifiable pathology or dysfunction of that subsystem" (Sandberg, 2011, p. 71)"

Through some form of brain-computer interface, we could enhance human capabilities, updating the 'software of the mind'. The advent of a technological singularity would lead humans to control and harness these superintelligent entities, "and computer-human interfaces may become so intimate that users may reasonably be considered superhumanly intelligent" (Vinge, 2013, p. 365). In 2019, American entrepreneur Elon Musk unveiled new goals for 'Neuralink': enhancing the cognitive abilities of individuals suffering from severe physical limitations. 'Neuralink' represents an unprecedented advancement in brain-machine interface, opening new possibilities for human enhancement (Fourneret, 2020). The emergence of such technologies has prompted philosophical reflection on how they may "impact or threaten ethically sensitive aspects of our lives such as personal identity and authenticity" (Alonso, 2022, p. 91).

2.1. Philosophical & bioethical boundaries

These concerns were articulated in the article published in *Nature*, 'Four ethical priorities for neurotechnologies and AI'. While neurotechnologies hold promising potential for the treatment of neurological diseases, the authors expressed their concern regarding the potential ethical implications of the development of neurotechnologies:

i. Neural data from many willing sharers, combined with massive amounts of non-neural data — from Internet searches, fitness monitors and so on— could be used to draw ‘good enough’ conclusions about individuals who choose not to share. To limit this problem, we propose that the sale, commercial transfer and use of neural data be strictly regulated. Such regulations — which would also limit the possibility of people giving up their neural data or having neural activity written directly into their brains for financial reward— may be analogous to legislation

that prohibits the sale of human organs, such as the 1984 US National Organ Transplant Act (Yuste et al., 2017, p. 161).

ii. Neurotechnologies could clearly disrupt people's sense of identity and agency and shake core assumptions about the nature of the self and personal responsibility —legal or moral. [...] We recommend adding clauses protecting such rights ('neurorights') to international treaties, such as the 1948 Universal Declaration of Human Rights" (ibid., p. 162).

iii. The pressure to adopt enhancing neurotechnologies, such as those that allow people to radically expand their endurance or sensory or mental capacities, is likely to change societal norms, raise issues of equitable access and generate new forms of discrimination (ibid.).

iv. We advocate that countermeasures to combat bias become the norm for machine learning. We also recommend that probable user groups (especially those who are already marginalized) have input into the design of algorithms and devices as another way to ensure that biases are addressed from the first stages of technology development" (ibid.).

The ability to expand or enhance the 'software of the mind' raises profound ethical questions regarding the integrity and autonomy of individuals. If the aforementioned brain-computer interfaces were to be safely developed, they could assist many individuals with motor disabilities in regaining or enhancing their mobility. However, it is important to consider associated risks, both in terms of the safety and efficacy of the implants and concerning the invasion of privacy and potential manipulation of the human mind.

What would be the implications of accessing and modifying 'mind software' in terms of privacy and security of mental data? How would free and informed consent be ensured for individuals opting for these interventions? Is there a risk of a new socioeconomic divide, where only those with resources can access these technologies, thereby exacerbating inequality in cognitive enhancement?

3. Mind uploading

The resemblance between the human brain and computers has inspired scientists and engineers to contemplate the functioning of the human brain and the possibility of emulating artificial minds. If we were to understand the human mind as a kind of software, it could be updated and, therefore, improved, acquiring new capabilities artificially. The mind could also be copied into a non-biological device. According to transhumanists, the mind's copy could be achieved by transferring all the information from our brain through, for instance, a neuroscan of mental information (Biscaia-Fernández, 2021). If the mind is a program, then it is merely a long sequence of instructions in a programming code.

> Your brain is a material object. The behavior of material objects is described by the laws of physics. The laws of physics can be modeled on a computer. Therefore, the behavior of your brain can be modeled on a computer (Merkle, 2013, p. 157).

The computational approach abstracts from the specific implementation details of a cognitive system. Therefore, it focuses on a higher level of analysis: the calculations, algorithms, or programs that a system executes to generate its behavior, "the mind is the program running on the hardware of the brain. That is, the mind is the algorithm the brain implements" (Schneider, 2019, p. 78). The material in which a mind is implemented can be either carbon or silicon. According to the computational approach, artificial consciousness is not only possible but likely to occur in the future: "computationalists, with their emphasis on formal algorithmic accounts of mental functions, tend to be amenable to machine consciousness because they suspect that other kinds of substrates could implement the same kind of computations that brains do" (ibid., p. 24).

Within this framework, identity is a specific pattern of information, and if this could be replicated in an artificial device, personal identity could be preserved. This leads to arguments in favor of 'digital immortality'. We are not ordinary physical objects: our minds would be programs. Therefore, if the brain were scanned, and the scanned product 'copied' the neuronal configuration, i.e., the 'pattern of information', personal identity could survive. If the pattern of information survives, identity survives because "the mind is akin to what mathematicians and computer scientists call 'information', for

brevity, a nonrandom pattern of data" (ibid., p. 125). These arguments open up the possibility of life after brain death. For Nick Bostrom (2009, p. 66):

> Uploading refers to the use of technology to transfer a human mind to a computer. This would involve the following steps: First, create a sufficiently detailed scan of a particular human brain, perhaps by feeding vitrified brain tissue into an array of powerful microscopes for automatic slicing and scanning. Second, from this scanning data, use automatic image processing to reconstruct the 3-dimensional neuronal network that implemented cognition in the original brain, and combine this map with neurocomputational models of the different types of neurons contained in the network. Third, emulate the whole computational structure on a powerful supercomputer (or cluster). If successful, the procedure would a qualitative reproduction of the original mind, with memory and personality intact, onto a computer where it would now exist as software.

If we could fully map and understand the patterns of information and mental processes occurring in the brain, it would theoretically be possible to copy or transfer them to a non-biological substrate, such as a computer or a digital network. With the progressive advances in artificial intelligence and quantum computing, it would be feasible to emulate complex cognitive functions and do so on a substrate other than the biological. Limitations of personal identity would be overcome both at the biological and geographic levels.

Suppose humans eventually colonize other planets or stellar systems. The computational approach suggests that we could send digital representations of our minds instead of taking our physical bodies to these places. This would allow for an expanded personal identity in cosmic space. From the perspective of computational identity, the Internet is an ideal medium for identity expansion. The global network enables access to new knowledge and mobility beyond physical limitations in a digital space. The new digital entity could access new information, data, and experiences, updating and enhancing its own information and knowledge. Problem-solving capacity would be much higher, bypassing the limitations of embodied minds.

Finally, stemming from the flexible and expansive nature of the computational approach, it would be possible to enhance individual autonomy. The possibility of accessing greater knowledge freely and openly, and the overcoming of physical limits, would enable an expansion of possibilities for these 'future entities'.

Clearly, these ideas have been subject to criticism at many levels. For instance, technological solutionism and the notion of information "mean converting every vital and meaningful element into computable digits" (Ayala-Colqui, 2023, p. 233). For some authors, brain simulation is merely a form of duplication, of representation, and not the preservation of the original personal identity.

3.1 Philosophical & bioethical boundaries

The computational approach to the mind maintains that consciousness is a matter "of computational and information processing functions, any brain replacement that is precisely functionally equivalent to an individual brain would preserve its consciousness" (Piccinini, 2021, p. 139). However, a brain simulation "doesn't actually reproduce the computations performed by the original brain—it merely represents them" (ibid.). Even if the computational approach were true, "it is plausible that reproducing the original computations is necessary for consciousness" (ibid.). To achieve this, the simulation would likely have to run on hardware that mimics the neuronal circuit, meaning hardware that exhibits a sufficient degree of causal isomorphism with the neuronal circuit, "that would be closer to a brain replacement —albeit performed all at once in a location distinct from where the brain is— than an ordinary brain simulation" (ibid.). In other words, brain simulation is a form of duplication.

This explanation leads us to the biological approach to consciousness. The biological approach argues that conscious intelligence requires a set of biological conditions for its emergence. It would be highly challenging to have a conscious system that is not physically very similar to the biological brain:

> Biological naturalists suggest that consciousness depends on the particular chemistry of biological systems —some special property or feature that our bodies have and that machines lack. But no such property has ever been discovered, and even if it were, that wouldn't mean AI

> could never achieve consciousness. It might just be that a different type of property, or properties, gives rise to consciousness in machines (Schneider, 2019, p. 19).

Piccinini (2021, p. 142) proposes two conclusions that are not too optimistic:

i. Brain simulation is a case of duplication not survival. "If the original continues to exist, none of the simulations count as the survivor of the original, simply because the original is still there. Even if the original is destroyed in the process, none of the simulations has a privileged claim to being the survivor of the original".
ii. Brain replacement is consistent with survival. "This is because, each time one portion of a brain is replaced by a prosthetic device, there can be only one survivor: the one and only system consisting of the original system, minus the part that gets replaced, plus the prosthesis [...] It might be a viable option for digital immortality. Of course, this viability is predicated on brain replacement being feasible and producing consciousness using (extensions of) digital technology, neither of which is likely to be the case".

Gherab-Martin (2022, p. 193) outlines the extensive literature that posits limits to the computational approach, stating, "either the human mind is not a Turing machine, or there are mathematical problems that are unsolvable (both for natural and artificial minds)". Human thought would be irreducibly non-computable, and the human mind cannot be replicated as if it were a simple information pattern. In other words, the requisite conditions for its physical implementation would not be satisfied (Fernández-Cuesta, 2023). The complexity of the human mind remains a challenge that exceeds the capabilities of current technology. In fact, "in order to preserve consciousness, it would have to be based on technology that contains the physical basis of consciousness. We don't have any such technology, and we have no idea how to build it because we don't know what the physical basis of consciousness is" (Piccinini, 2021, p. 143). Summing up:

Premise 1: The brain is a material object, and the behavior of material objects is described by the laws of physics.

Premise 2: The laws of physics can be modeled on a computer.

Premise 3: We currently do not fully understand the physical basis of consciousness.

Conclusion: It is challenging to accurately model the behavior of the brain on a computer.

4. Welfare biology and wild animal suffering

The problem of suffering in nature is a highly relevant aspect of the philosophical problem of evil (Horta, 2015). The common perception that life in natural environments is good for animals is based on several unjustified judgments. Many people view nature as an original state perceived as the most suitable and authentic for animals. Some argue that animals have the right to live according to their own natural inclinations, and that humans should respect the autonomy of animals as much as possible. Some philosophical standpoints, such as biocentrism, maintain that nature and ecosystems have intrinsic value and deserve to be preserved and protected (Agar, 1997; Sterba, 2011; Taylor, 1983), which supports the idea that life in natural environments is good for animals. Kyle Johannsen (2020, p. 22) describes other arguments that reinforce this idyllic view:

> "To some extent, the positive view of nature is explained by survivorship bias. In particular, the belief that nature is idyllic reflects a failure on most people's part to use representative examples when imagining life in the wild. By and large, people tend to think of large, K-strategist mammals when they imagine examples of wild animals, for example, deer, bears, elephants, giraffes, etc. Large K-strategists are noticeable and they share numerous similarities with us, for example, they're sociable, have families, etc., so it's 'natural' enough that we're predisposed to think of

> them. But since most animals born into the world are r-strategists, our impression of what life is like for K-strategist mammals is unrepresentative of what life is like for wild animals in general. In fact, it's probably not even representative of what life is like for wild K-strategists themselves, as it isn't always obvious when wild animals feel ill or are in pain. One reason for this is that many prey species hide signs of sickness or injury in order to avoid giving predators the impression that they're vulnerable. To be fair, r-strategists sometimes come to mind, too, for example, bull frogs, crocodiles, etc. But when we think of bull frogs or crocodiles, most of us specifically envision them as mature adults, rather than as infants. As we already know, mature r-strategists are just as unrepresentative as K-strategists since the vast majority of r-strategists die during infancy".

Most people are aware that non-human animals suffer various types of harm in nature, causing them suffering, deprivation, mutilation, and premature death. However, "it is often considered that the suffering of animals in nature is just something that should occur because it is part of the processes that occur in nature" (Horta, 2015, p. 18). The pain and suffering inherent in life in nature would be justified by the aesthetic and contemplative appreciation of its beauty and complexity. Animal suffering in natural environments can be countered by the benefits we derive from appreciating the tragic beauty of natural life and the instrumental value of predation, "intrinsic disvalue is instrumental to intrinsic value" (Hettinguer, 2010, p. 132). Therefore, we should accept and respect the natural roles of animals in the food chain, "without romanticizing or demonizing their agonistic interactions" (Keulartz, 2016, p. 118).

Some authors (Torres, 2015, Johanssen, 2017; Horta, 2022; Faria, 2023) argue that humans have a responsibility to reduce the suffering of animals as much as possible. In nature, animals face constant threats such as predation, lack of food, and extreme weather conditions, leading to short lives characterized by significant suffering. Moreover, in many cases, humans have transformed nature in such a way that natural environments are no longer idyllic and can be detrimental to wildlife. The recent global environmental changes affirm that Earth has entered a new geological epoch dominated by humans, the Anthropocene, a term that emphasizes humanity's central role in ecological and geological transformation (Fernández-Mateo & Franco-Barrera, 2023, p. 298). In other words, this transformative responsibility carries a responsibility for what has been transformed.

Welfare biology is a new discipline that examines the condition of all sentient beings, with a value orientation towards the promotion of their well-being. The classic study by Ng (1995, p. 257), 'Towards Welfare Biology: Evolutionary Economics of Animal Consciousness and Suffering' defines welfare biology as follows:

> The study of living things and their environments with respect to their well-being or welfare. What is meant by "welfare"? An unpretentious and common-sense definition is adopted here. Welfare of an individual sentient is just its net happiness. The (net) happiness of an individual sentient over a period of time is the integral of its affective feelings over that period of time [...] What do we mean by positive and negative affective feelings? Positive feelings are those that feel good in themselves, including sensuous pleasures and spiritual delights. Negative feelings are those that feel bad in themselves, including sensuous pain and mental sufferings.

There are countless ways in which animals suffer in the wild. In 'Wild Animal Suffering', Catia Faria (2023) systematizes the various forms of suffering in the wild:

i. Physical injury "is a significant threat to the well-being of animals living in the wild. It constitutes a major source of wild animal suffering. Wild animals are frequently wounded, often fatally. A significant part of this suffering could be reduced, and many deaths eventually could be prevented if only medical treatment was provided" (2023, p. 69).
ii. Weather "constitutes a clear source of suffering for animal populations. This is the case even when weather is compatible with feasible survival conditions. Many animals die due to extreme weather conditions, but even those that manage to survive will often suffer from cold or severe heat. This happens because the climatic conditions that make it feasible for a population to survive in the wild are not always optimal, or even good, living conditions for its individual members" (ibid., p. 71).

iii. Psychological stress is a common form of wild animal suffering, "wild animals go through very stressful situations in their natural environments. For example, they experience physical trauma, live in places with a high density of predators or parasites, face conflicts with conspecifics, and have to endure constant variations of food, water, and temperature. In addition to how harmful in themselves these situations can be for animals, they also cause them to suffer from psychological stress" (ibid., p. 74)

iv. Predation "is, perhaps more vividly than any other natural event, a major source of wild animal suffering and death" (ibid., p. 80). We tend to believe that predators kill their prey quickly and cleanly, influenced by the images presented in nature documentaries. However, the reality is quite different: being prey involves enduring a prolonged and painful agony, where one fights for life with all their strength, sometimes for hours.

v. Parasitism is another common form of suffering, where one organism exploits another to the point of causing its death. Animals in the wild "are prone to be infected by a large number of parasites. They are also highly susceptible to other different forms of disease. In the overwhelming majority of cases, these conditions either cause huge suffering to the animals or are responsible for bringing about their deaths by direct or indirect means, that is, by increasing their susceptibility to predation and other harmful events" (ibid., p. 80).

If wild animals have the capacity to have positive experiences but die prematurely, not only is harm inflicted on the animal at the moment of its death, "the fact that they die prematurely is a disvalue as well" (Horta, 2015, p. 27). In other words, we deprive animals of having positive experiences in the future. This loss of potential is a disvalue that adds to the direct harm caused by death. Therefore, we could imagine a world in which wild animals have more opportunities to live long and happy lives, and that world would be a better world from the perspective of the animals' interests. This argument implies that we have a moral obligation to intervene in nature to prevent or alleviate the suffering and premature death of wild animals, whenever possible and beneficial to them (Sapontzis, 1984).

4.1. Editing nature

Using the CRISPR editing tool, Chinese scientists inserted genes that express spider silk proteins into the silk gland secretory cells of silkworms. This was done while they were still inside the eggs through microinjections. After hatching, they allowed these genetically modified silkworms to complete their life cycle, including the moth stage, where they mated with others that had not been genetically modified. In the subsequent generation, they selected several silkworms, some of which were genetically modified. All of them were capable of secreting silk, and after the spinning process, the silk was analyzed to determine its chemical structure and mechanical properties. It was discovered that the silk thread produced by the genetically modified silkworms exhibited impressive strength and toughness (Mi et al, 2023). There are ethical reasons against using these animals as resources for human purposes (Horta, 2010). However, there are also ethical reasons to utilize this technology to enhance their well-being.

For proponents of welfare biology, there are compelling reasons for large scale intervention in nature. Predation, the r-strategy, and other natural processes are responsible for a vast amount of suffering, and although such intervention carries risks and requires caution, it is justified. Through CRISPR, a recent type of genetic editing with the power to significantly alter the natural world:

> One especially promising type of intervention is gene editing. CRISPR, the latest form of gene editing, has received a considerable amount of attention in the media over the last four years, and for good reason. For one, it's both cheap and easy to use. Whereas earlier forms of gene editing required costly materials and a considerable amount of specialized expertise in protein engineering, CRISPR has comparably low material costs, and it edits the desired part of a genome via an easily modified RNA molecule (Johannsen, 2017, p. 68).

Gene drives are a biotechnology that involves introducing genetic modifications into certain individuals of a species, so that they are passed on to their descendants and spread throughout the population. This biotechnology could be used to enhance the welfare of wild animals by reducing or

eliminating some of the factors that cause them suffering, such as diseases, parasites, predators or resource scarcity. Gene drives are preferable to other forms of conventional wildlife management, such as hunting or sterilization.

According to Johannsen (ibid., p. 69), gene drives "are preferable to conventional wildlife management is because the harms of gene drives are initial, rather than perpetual, and because those harms are inflicted on only a small subset of each target population, rather than the entire population" The implementation of gene drives involves modifying a small group of edited organisms, which, once released into their natural environment, transmit the desired traits to wild populations. Future members of the population do not necessarily have to experience any harm at all. The use of gene drives for the purpose of improving the welfare of wild animals is fully compatible with allowing the majority of these animals to continue living freely and without interference in their natural lives. As we pointed out at the outset, this surprising technology "has already been used, with some degree of success, to perform gene edits that promise to improve the welfare of farmed animals, for example, by creating resistance to tuberculosis and by preventing horn growth" (ibid., p 71).

4.2. Philosophical & bioethical boundaries

'Hard' welfare biology presents significant ethical challenges that must be carefully addressed. Christine Korsgaard rejects the new discipline she calls 'Creation Ethics'. According to Korsgaard (2018, p. 187), although the reproductive functioning of nature is something horrifying, it is the reality of animal and natural life. Eliminating predation might be a tempting idea (McMahan, 2015), but it would have a drastic impact on the dynamics of animal life:

> Nature itself is a kind of gigantic factory farm, producing billions of miserable short-lived creatures just to feed a very few others. From a moral point of view, it is a horror. But nevertheless, these facts determine the content, the substance, of animal life. What animals do is eat, hunt, forage, and produce and often feed and raise their offspring. If they didn't have to do those things, it is not clear what their lives would consist in.

In contrast, Paez (2020, p. 291, p. 293) argues that a sentient Kantian theory is compatible with the possibility of modifying nature and animals to lead better lives. It would be morally permissible to redesign nature and the animals themselves:

> Most animals reproduce by having huge quantities of offspring, of which only two on average reach sexual maturity. The rest die shortly after hatching, often painfully. Gene drive technology could allow us to change this reproductive strategy or reprogramme predators into herbivores. We may 'engineer paradise', to borrow David Pearce's phrase [...] Most sentient beings are wild animals with probably net negative existences. We may acquire the means to re-engineer nature for their benefit. If morality forbade us to do so, it would be fair for quintillions to endure preventable suffering. Nevertheless, we need not believe that would be fair. A sentientist Kantian theory is compatible with permission to engineer paradise and even with a requirement to amend nature, and the organisms of sentient beings, so that they have reasonably good lives.

One of the major criticisms of large-scale welfare biology approach can be found in the paper of Nicolas Delon and Duncan Purves (2018) titled 'Wild Animal Suffering is Intractable'. The authors argue that a risk-free intervention is justified. However, the indeterministic nature of ecosystems prevents ensuring an intervention without increasing suffering:

> Our concerns derive from an appreciation of the complexity of ecosystem interactions, the effects these interactions might have on the resilience and integrity of ecosystems, and the largely unexplored relationship between ecosystem integrity and wild animal well-being. Because interventions to prevent wild animal suffering adversely affect ecosystem resilience and integrity, and because ecosystem resilience and integrity can bear directly on the well-being of animals, we are not justified in believing that interventions to prevent wild animal suffering will prevent rather than exacerbate suffering in the wild (Delon & Purves, 2018, p. 241).

Sentient beings cannot isolate themselves from nature: we live in an integrated whole of interdependencies and interactions (Catton & Dunlap, 1978). Humans are just one species among the many that participate interdependently in the biotic communities that allow the development of life. These communities are composed of cause-and-effect links and feedback relationships within the web of nature, the modifications of which can produce unforeseen consequences. The Norwegian philosopher Arne Næss (1989, p. 79) asserts:

i. A human being is not a thing in an environment, but a juncture in a relational system without determined boundaries in time and space.
ii. The relational system connects humans, as organic systems, with animals, plants, and ecosystems conventionally said to be within or outside the human organism.
iii. Our statements concerning things and qualities, fractions and wholes cannot be made more precise without a transition to field and relational thinking.

Let's consider an example. An intervention to modify r-strategists would reduce the fertility of prey species, but then, "one must then confront the risk of extinction posed to r-strategists by the reduction in fertility, and, relatedly, one must then worry about the effect of reducing the prey population on predator species that rely on them for survival". Therefore, "changing the reproductive behavior of a species can have unintended effects on (1) the modified species, (2) species that interact with the modified species, and (3) the functioning of the ecosystem of which the modified species is a part" (Delon & Purves, 2018, p. 246). Consequently, if we reduce the quantity of prey available, predators will also suffer because they won't have enough food and could face extinction.

Johannsen's (2017) proposed solution is to develop plants that predators can eat instead of prey. He believes this is possible thanks to advances in CRISPR gene-editing technology, although further research is needed to confirm its viability. However, the introduced plants could become invasive, reducing the available food for the existing prey species. And, obviously, the predator species would need to be modified as well. If we add the uncertainty that will be caused by an aggressive climate scenario, as indicated by models, ecosystem behaviors will be unpredictable.

As a result, there are cases in which preventing predation would originate more suffering than it would prevent:

Premise 1: Modifying the integrity of ecosystems can directly impact the welfare of wild animals.

Premise 2: CRISPR gene-editing technology can lead to unintended consequences.

Conclusion: It is questionable whether CRISPR gene-editing technology can decrease wild animal suffering and, therefore, be a reasonable measure.

4.3. 'Soft' welfare biology is tractable

Kirkwood & Sainsbury (1996, p. 241) argue that "there are sound arguments for not intervening for the welfare of free-living wild animals that are sick or injured as a result of natural processes, except perhaps to euthanize individuals that may be suffering from severe pain or distress." However, treatment and rehabilitation are considered appropriate measures when the harm has been caused directly or indirectly by humans, or when the injured animals are, to some extent, under human care. These arguments fall within a small-scale welfare biology framework.

Horta and Teran (2023) contend that there are many types of projects aimed at reducing wild animal suffering. Public and private initiatives have developed projects that include "rescue centers, wild animal hospitals and orphanages, where sick, injured or orphaned animals who would otherwise probably die are taken care of. In some cases, feeding projects conducted during especially harsh winters, or during droughts, save the lives of many starving animals. Finally, other projects help animals much more extensively. The clearest example may be wild animal vaccination programs". Unlike other experimental proposals, these measures carry a lower ecosystem risk and appear to be entirely justified.

When thinking about wild animals, most people tend to imagine them living in natural habitats, but many of them share their space with humans in areas known as synanthropic areas. Horta and Teran (2023) argue that "a good starting point for measures that aim to reduce wild animal suffering could be to implement programs that aim to improve the lives of synanthropic animals." These programs could gather valuable information in a new research field that has not received significant resources. The knowledge gained in synanthropic areas through vaccination programs or antiparasitic measures could allow inferences in habitats further from human presence. Some methods that would not be impracticable include:

i. Disease eradication and contraception. Combining disease treatment with contraceptive measures addresses both immediate suffering and long-term concerns related to the population of wild animals.
ii. Ecosystem management. In a given ecosystem, if reforestation were to improve the conditions for a specific species, allowing them to live longer and experience overall higher well-being, then we would have reasons to favor reforestation. However, if reforestation had a negative impact on a particular species, for example, by reducing their sources of food or shelter, which would decrease their well-being, then we might have reasons to oppose reforestation.

5. Conclusions

Welfare biology should not be considered a perfect and complete discipline but rather as an area of study that is willing to evolve with knowledge and experience. Just as conservation biology understands that there are reasonable, unpredictable risks, welfare biology should be recognized as a new discipline with reasonable risks. It is about acknowledging that this discipline is dynamic and constantly evolving, with its primary goal being to improve the welfare of wild animals as deeper knowledge is gained in this area.

The concerns raised by experts in neurotechnologies are evidently well-founded on social, economic, and political levels. Although digital transformation presents vast opportunities for improving human welfare, it also introduces threats to human rights on an unprecedented scale. Regulatory measures must be implemented to ensure equal access to these opportunities while mitigating potential future socioeconomic disparities. Furthermore, within the current state of scientific knowledge, the concept of mind uploading appears to be a fundamentally speculative philosophical idea.

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References

Alonso, M. (2022). Tecnologías cerebro-afectantes, identidad personal y autenticidad. *Bajo Palabra*. Revista de filosofía, (30), 83-96. https://doi.org/10.15366/bp2022.30.004

Álvarez Díaz, J. A. (2023). The future of human reproduction: Ectogenesis and transhumanism? *TECHNO REVIEW. International Technology, Science and Society Review*, 13(3), 1–11. https://doi.org/10.37467/revtechno.v13.4796

Agar, N. (1997). Biocentrism and the Concept of Life. *Ethics*, 108(1), 147-168.

Ayala-Colqui, J. (2023). El nacimiento del "ciberalismo". Una genealogía crítica de la gubernamentalidad de Silicon Valley. *Bajo Palabra*, (32), 221-254. https://doi.org/10.15366/bp2023.32.012

Biscaia Fernández, J. M. (2021). Neuromejora: de la vanguardia científica y tecnológica a las dificultades y límites planteados por la filosofía de la mente y la bioética. *Revista Iberoamericana De Bioética*, (16), 01–17. https://doi.org/10.14422/rib.i16.y2021.003

Bostrom, N. (2009). The future of humanity. *Geopolitics, History, and international relations*, 1(2), 41-78.

Capone, N., & Albert Márquez, J. J. (2022). Reconsidering the paradigm "death" form transhumanism: Will death remain only and illusion? *HUMAN REVIEW. International Humanities Review*, 13(5), 1–11. https://doi.org/10.37467/revhuman.v11.4068

Catton Jr, W. R., & Dunlap, R. E. (1978). Environmental sociology: A new paradigm. *The American Sociologist*, 41-49.

Delon, N., & Purves, D. (2018). Wild animal suffering is intractable. *Journal of Agricultural and Environmental Ethics*, 31, 239-260. https://doi.org/10.1007/s10806-018-9722-y

Faria, C. (2023). *Animal ethics in the wild: Wild animal suffering and intervention in nature*. Cambridge University Press.

Faria, C. (2023). Vulnerability and the Ethics of Environmental Enhancement. *Ethics, Policy & Environment*, 1-19. https://doi.org/10.1080/21550085.2023.2200725

Fernández-Cuesta, J. A. (2023). Do Accelerating Turing Machines Exist? Paradoxes and Logical Possibilites. *TECHNO REVIEW. International Technology, Science and Society Review*, 13(1), 49–74. https://doi.org/10.37467/revtechno.v13.5005

Fernández-Mateo, J., & Franco-Barrera, A. J. (2023). Responsible Consumption and Production in the Anthropocene: Animal Ethics and the Sustainable Development Goals. *Rev. Bioetica & Derecho*, 57, 287. https://doi.org/10.1344/rbd2023.57.38250

Fourneret, É. (2020). The hybridization of the human with brain implants: the neuralink project. *Cambridge Quarterly of Healthcare Ethics*, 29(4), 668-672.

Gherab-Martin, K. (2022). Mentes contra Máquinas: Revisión histórica y lógico-filosófica del argumento gödeliano de Lucas-Penrose. *HUMAN REVIEW. International Humanities Review*, 11(2), 185-195. https://doi.org/10.37467/revhuman.v11.4503

Hettinger, N. (2010). Animal beauty, ethics, and environmental preservation. *Environmental Ethics*, 32(2), 115-134.

Horta, O. (2010). What is speciesism? *Journal of agricultural and environmental ethics*, 23, 243-266. https://doi.org/10.1007/s10806-009-9205-2

Horta, O. (2015). The problem of evil in nature: Evolutionary bases of the prevalence of disvalue. *Rel.: Beyond Anthropocentrism*, 3, 17. https://doi.org/10.7358/rela-2015-001-hort

Horta, O. (2022). *Making a stand for animals*. Routledge.

Horta, O., & Teran, D. (2023). Reducing Wild Animal Suffering Effectively: Why Impracticability and Normative Objections Fail Against the Most Promising Ways of Helping Wild Animals. *Ethics, Policy & Environment*, 1-14. https://doi.org/10.1080/21550085.2023.2200726

Johannsen, K. (2017). Animal rights and the problem of r-strategists. *Ethical Theory and Moral Practice*, 20(2), 333–345. https://doi.org/10.1007/s10677-016-9774-x

Johannsen, K. (2020). *Wild animal ethics: The moral and political problem of wild animal suffering*. Routledge.

Kirkwood, J. K., & Sainsbury, A. W. (1996). Ethics of interventions for the welfare of free-living wild animals. *Animal Welfare*, 5(3), 235-243. https://doi.org/10.1017/S0962728600018820

Keulartz, J. (2016). Should the lion eat straw like the ox? Animal ethics and the predation problem. *Journal of Agricultural and Environmental Ethics*, 29(5), 813-834. https://doi.org/10.1007/978-3-030-63523-7

Korsgaard, C. M. (2018). *Fellow creatures: Our obligations to the other animals*. Oxford University Press.

Mababu Mukiur, R. (2022). Análisis de las competencias claves para la industria 4.0: Las competencias para la Industria 4.0. *TECHNO REVIEW. International Technology, Science and Society Review*, 12(1), 1–15. https://doi.org/10.37467/revtechno.v11.4392

McMahan, J. (2015). The moral problem of predation. In: *Chignell, A., Cuneo, T., & Halteman, M. C. (Eds.). Philosophy comes to dinner: Arguments about the ethics of eating. Routledge.*, 268-94.

Merkle, R. C. (2013). Uploading. In: More, M., & Vita-More, N. (Eds.). *The transhumanist reader: Classical and contemporary essays on the science, technology, and philosophy of the human future*. John Wiley & Sons, 157-164.

Mi, J., Zhou, Y., Ma, S., Zhou, X., Xu, S., Yang, Y., ... & Meng, Q. (2023). High-strength and ultra-tough whole spider silk fibers spun from transgenic silkworms. *Matter*. https://doi.org/10.1016/j.matt.2023.08.013

Næss, A. (1990). *Ecology, community and lifestyle: outline of an ecosophy*. Cambridge University Press.

Ng, Y. K. (1995). Towards welfare biology: Evolutionary economics of animal consciousness and suffering. *Biology and Philosophy*, 10, 255-285. https://doi.org/10.1007/BF00852469

Paez, E. (2020). A Kantian ethics of paradise engineering. *Analysis*, 80(2), 283-293. https://doi.org/10.1093/analys/anz077

Piccinini, G. (2021). The myth of mind uploading. In: *The Mind-Technology Problem: Investigating Minds, Selves and 21st Century Artefacts*, 125-144. Springer. https://doi.org/10.1007/978-3-030-72644-7

Sandberg, A. (2011). Cognition enhancement: Upgrading the brain. In: Savulescu, J., Sandberg, A., & Kahane, G. (Eds.) *Enhancing human capacities*, Wiley-Blackwell, 69-91.

Sapontzis, S. F. (1984). Predation. *Ethics and animals*, 5(2), 4.

Schneider, S. (2019). *Artificial you: AI and the future of your mind*. Princeton University Press.

Shih, J. J., Krusienski, D. J., & Wolpaw, J. R. (2012). Brain-computer interfaces in medicine. In: *Mayo clinic proceedings* Vol. 87, No. 3, pp. 268-279. Elsevier. https://doi.org/10.1016/j.mayocp.2011.12.008

Sterba, J. P. (2011). Biocentrism defended. *Ethics, Policy & Environment*, 14(2), 167-169. https://doi.org/10.1080/21550085.2011.578376

Taylor, P. W. (1983). In defense of biocentrism. *Environmental Ethics*, 5(3), 237-243. https://doi.org/10.5840/enviroethics19835322

Torres, M. (2015). The case for intervention in nature on behalf of animals: A critical review of the main arguments against intervention. *Rel.: Beyond Anthropocentrism*, 3, 33. https://doi.org/10.7358/rela-2015-001-torr

Vinge, V. (2013) Technological singularity. In: More, M., & Vita-More, N. (Eds.). *The transhumanist reader: Classical and contemporary essays on the science, technology, and philosophy of the human future*. John Wiley & Sons, pp 365-375.

Yuste, R., Goering, S., Arcas, B. A. Y., Bi, G., Carmena, J. M., Carter, A., ... & Wolpaw, J. (2017). Four ethical priorities for neurotechnologies and AI. *Nature* 551, 159–163 https://doi.org/10.1038/551159a