

# SHOULD POSTHUMAN BE (HUMAN)-ENHANCEMENT BASED? THE MEANING OF POSTHUMAN PROJECT IN THE AGE OF CLIMATE CHANGE AND SPACE TRAVELLING

---

Maurizio Balistreri\*

## **Abstract**

Trans-humanism and post-humanism converge on the importance of promoting the birth of the post-human, an individual with capacities “greatly exceeding the maximum attainable by any current human being without recourse to new technological means”. A project of this type indeed has nothing therapeutic about it, so it does not concern the field of medicine. However, this does not mean it cannot be a morally acceptable project. If we consider the use of biotechnologies approvable when their purposes are therapeutic, then we should all the more accept (or see as mandatory) the use of these technologies for the purposes of improvement, in that at times only enhancement allows the quality of life to be improved. Even if we agree with Stefan Lorenz Sorgner that plans for human enhancement cannot be considered intrinsically immoral, we intend to demonstrate that enhancing human skills is not the only reason that can justify a programme to replan human nature and promote the ‘posthuman’. In our opinion, a more coherent posthuman plan should take into account the possibility of overcoming the traditional conception of the human more radically than we have thus far done.

## **Keywords**

Bioethics, posthumanism, transhumanism, climate change, space travelling

## **1. Introduction**

Unlike the more traditional conception of trans-humanism, post-humanism and meta-humanism defend a new conception of humanism, which places at the centre

---

\* Department of Linguistics and Literary, Historical, Philosophical and Legal Studies (DISTU), University of Tuscia, Viterbo, Italy.

a conception of human beings as entities that can no longer be ontologically distinct from other living beings (Sorgner, 2021, p. 186). But even if these conceptions propose a more modest conception of the human being than the conception we find in the more traditional paradigms of humanism, they support the desirability, and in part the necessity, of modifying and enhancing human nature. There are differences, Stefan Lorenz Sorgner (2016/2020) explains, on how trans-humanists conceive of the post-human, in that post-human may designate both a species apart from the human being and the completion of a path which—passing through current humanity—permits a new form of a human to be brought into the world. For example, the conception of the post-human that Nietzsche proposes is not the one we find in the works of Nick Bostrom (or in other trans-humanists):

In light of the above concepts of the posthuman, I conclude – Sorgner states – that Nietzsche’s concepts of higher humanity and of the overhuman resemble Esfandiary’s concepts of the trans- and posthuman, but not Bostrom’s. According to Nietzsche, members of the human species can usually develop characteristics only within the limits of our species. (Sorgner, 2016/2020, p. 67)

Yet both perspectives converge on the importance of promoting the birth of the post-human, i.e. an individual with capacities “greatly exceeding the maximum attainable by any current human being without recourse to new technological means” (Sorgner, 2016/2020, p. 66; Bostrom, 2009, p. 108). This is an idea that Sorgner reaffirms in his book *We Have Always Been Cyborgs* (2022):

Transhumanism is a cultural movement which affirms the use of techniques to increase the likelihood that human beings manage to transcend the boundaries of their current existence. It is in our interest to take evolution into our own hands. Thereby, we will increase the likelihood of our living a good life as well as that of not becoming extinct. (p. 5)

The strong embrace of enhancement technologies, Sorgner says, is the defining feature of transhumanism and its most innovative ingredient. Transhumanists support the enhancement of emotional, physical and mental abilities and that’s why Sorgner regards “gene technologies as well as cyborg technologies as the most promising means for expanding human boundaries” (Sorgner, 2021, p. 8). It is true that such a project has nothing therapeutic about it, so it no longer concerns the field of medicine, but this does not mean that it cannot be a morally acceptable plan. If indeed, we consider the use of biotechnologies approvable because they have therapeutic purposes, then we should all the more accept (or see as mandatory) the use of these technologies for the purposes of improvement, in that at times only enhancement allows the quality of life to be improved (Sorgner, 2021, pp. 8–9). Even if we agree with Sorgner that plans for human (bio)enhancement (of both cognitive and mental/psychological skills) cannot be seen as intrinsically immoral, we intend to sustain that enhancing human capacities is not the only reason that can justify a programme to replan human nature and to promote the *post-human*. Not only can we

imagine situations in which overcoming the current human condition could be a morally acceptable (or even imperative) plan, even if it brings about no enhancement of our capacities or dispositions, but we can also think that replanning human nature (without involving an enhancement of abilities) may be a more desirable objective than any project that permits (bio)enhancement of *natural* human skills and dispositions. For us, the fact that replanning human nature (which does not pass for the enhancement of human skills) may seem a more desirable objective than any enhancement that resizes the value transhumanists attribute to bioenhancement. That is, transhumanists state that the “key premise of transhumanism is the desirability of becoming posthuman” (Sorgner, 2016/2020, p. 5), and the most desirable post-human project is the one based on (bio)enhancing our skills and dispositions (Sorgner, 2021, p. 20). Yet, forms that plan the human (and consequently produce the *post-human*) and are not based on enhancing our skills may also be important objectives for us (and, as we have said, also more important objectives than any enhancement of our abilities). We, therefore, believe that anyone supporting the cause of transhumanism (and the importance of the post-human) should not limit himself to defending a single programme for overcoming the human and recognise that there may be various reasons for replanning the human. This is not a simple option, but, for Sorgner, a mandatory choice, since he believes that there is a radical plurality of the *good* and the individual physiopsychological requirements differ too greatly to allow for any nonformal, universally valid description of the good life (Sorgner, 2016/2020, p. 84; Sorgner, 2021).

To demonstrate that the post-human plan cannot be reduced to (or identified with) (bio)enhancing human abilities and dispositions, we shall first and foremost consider the possibility of turning to genome editing as the ideal solution to the environmental crisis. Some experts have proposed using genome editing interventions in agriculture, such as to reduce the water or space requirements of plants or increase their yield or ability to absorb carbon dioxide. It has also been stated that results that are no less important in protecting the environment and climate could be obtained through interventions modifying human beings genetically. Genome editing could be used not only to morally improve human beings and make them more sensitive to nature and the interests of future generations but also to make them more suitable for dealing with a less hospitable climate and reduce their impact on the planet’s resources (Balistreri & Umbrello, 2022c). This can be done, for example, by making human beings intolerant to the consumption of meat, causing them to be born with a smaller body or reducing their food requirements. In our opinion, facing this literature shows that replanning human nature (and consequently creating the post-human plan) can also be morally acceptable when it does not imply (bio)enhancing our (natural) skills and dispositions. After examining and discussing the moral acceptability of replanning human nature for non-therapeutic or medical purposes, but *merely* for environmental purposes, we will consider a recent debate that considers turning to genome editing as a necessary tool for allowing human beings to explore and colonise space. For Sorgner, planning the new human necessarily implies enhancement, in that the post-human incarnates human features at an increasingly high or superior level (Sorgner, 2021, pp. 94–97). Yet reflecting on

space travel and colonising other planets shows that it is possible to imagine the desirability of overcoming the human (and consequently planning the post-human) that does not pass for enhancing or improving his *natural* features—that, this means, forms to replan the human (and consequently plan the post-human) which are not based on enhancing our skills may also have value (and also be for us more important objectives than any other enhancement of our abilities).

## 2. The Posthuman Project in the Age of Climate Change

Due to the consumption of non-renewable resources, deforestation, the alteration of ecological balance, and pollution, the Earth could become an ever more less hospitable place. This is in addition to the fact that a further increase in the world's population might jeopardise or compromise the interests of future generations in an irreversible way (Liao, 2017). But today, the greatest worry is global warming, caused by human activity through the emission of greenhouse gases such as water vapour, carbon dioxide, methane, nitrogen etc. (IPCC, 2018). In some northern regions, an increase of 1.5 degrees Celsius could also raise agricultural production, but in southern regions, harvests may collapse significantly. Furthermore, as well as reducing biodiversity, a warmer climate makes forest fires, hurricanes, and floods more frequent and intense, with severe consequences for habitations and infrastructures (IPCC, 2021). Similarly, because of thermal expansion and glacial melt, ocean levels will gradually rise so that some lands—now densely populated and cultivated—could be completely submerged. In the face of these scenarios, we are becoming ever more aware that each of us is called to contribute to safeguarding the environment as well as adopting different lifestyles and behaviours such as reducing the consumption of energy and non-renewable resources, as well as increasing our recycling efforts. Yet, as Ingmar Persson and Julian Savulescu (2012) have well explained, we have a problem here, in that the contribution each of us can individually give to safeguarding the environment is functionally negligible. Hence, it may be wise to change our behaviour only if others do so as well, otherwise, we would have given up a benefit without obtaining any advantage in return. But it does not seem rational to put our trust into other people's willingness to cooperate. This is primarily on account of the fact that we are engaging in a collaborative enterprise that involves billions of people, and it is consequently difficult to discover (and then sanction) who benefits from the advantage of the co-operation opportunistically.

Further, the controversies characterising the debate on climate worsen matters: the fact that it is not always possible to make a precise estimate regarding the exact effect of greenhouse gas emissions on the environment and the consequences of concentrating greenhouse gases on the climate could give the impression that climate change is not so significant or so sudden after all:

It is controversial to what precise extent our emission of greenhouse gases affects the climate, e.g. what temperature increases will go with what concentrations of carbon dioxide in the atmosphere. Nor is there a consensus about whether these climatic changes will be so great or abrupt that they will seriously harm humans. Thus, it is a matter of

some controversy as to what extent we are called upon to reduce our emission of greenhouse gases to ensure we do not cause considerable deterioration of conditions of life on Earth in the future. (Persson & Savulescu, 2021, pp. 73–74)

And the fact that climate change will mainly concern future generations does not favour the perception that we are dealing with *urgent* problems demanding an immediate response, in that—Persson and Savulescu state—we have a natural inclination towards optimism, meaning that we tend to think that problems will find a solution over time. As such, we fail to find feelings of solidarity and compassion towards outsiders easily. We can also (rationally) understand that our behaviour will have dramatic consequences for the lives of the generations that will follow us. However, this (rational) awareness may not suffice to motivate us to act accordingly, in that our empathy is limited, and it is difficult to extend it through the imagination. Moreover, we should not only consider that future generations are *distant* in time. There is also another issue: it is one thing to empathise with a (single) person standing before us; it is another to imagine the suffering of a considerable number of people vividly. That is, the more the number of people rises, the less adequately our empathy will respond:

While many of us are capable of vividly imagining the suffering of a single subject before our eyes and, consequently, of feeling strong compassion for this subject, we are unable to imagine vividly the suffering of, say, ten subjects even if they be in sight—indeed, we could barely vividly imagine the suffering of more than one subject. Nor could we feel compassion which is ten times as strong as the compassion we could feel for a single sufferer. (Persson & Savulescu, 2012, p. 30)

Finally, due to our moral irresponsibility, even if we manage to get in tune with future generations via our imagination, we might still have difficulty believing that their lives could become genuinely unbearable or lead an unworthy life. As Persson and Savulescu say (2012, pp. 84–85), this is the consequence of the fact that habit has a significant effect on our imagination.

Because of these motivational limits, liberal-democratic societies may be unable to solve the environmental crisis. It requires policies that are effective in reducing or stopping the emission of greenhouse gases. However, few of us would support policies involving a drastic reduction in consumption. We would not only need to pass from a (mainly red) meat-based diet to a vegetarian one; we would also have to reduce car or aeroplane journeys to a sizeable degree. Also, to limit further demographic growth, we should reduce birth rates globally:

It seems unlikely that the citizens of Western democracies will voluntarily consent to such harsh restraints. (...) This is not just because the citizens will have to sacrifice a lot of comfort and entertainment to which they have grown accustomed, which is something that most people would be loath to do. It is also because

these sacrifices will be useless, and will have no appreciable effect upon the climate and environment unless a sufficient number of other individuals follow suit. (Persson & Savulescu 2012, pp. 79–80)

Further, in order to work, an environmental policy should be adopted internationally. Any agreement to reduce emissions is insufficient in the absence of supranational organisations able to apply possible sanctions to countries not respecting the agreements. Still, at the international level, the *classic* problems of co-operation, i.e., freeriding, arise. It would not be rational for a country to reduce its consumption (and consequently wellbeing) as long as it cannot be confident that other countries will cooperate.

However, in the face of the environmental crisis that liberal democratic societies must tackle, progress in the field of biology and genetics seem to offer a possible way out and allow a reduction in greenhouse gas emission without (any) need to limit or reduce consumption (hence without the need to turn to policies that risk being too unpopular). To reduce climate change, the suggestion that has been put forward is to modify nature or to replan human beings through (designed) genome editing interventions. For example, interventions on the genetic heritage of plants might raise harvests and the yield of pastures. These interventions might include making the plants more productive, more resistant to insects, parasites and herbicide, as well as render these products easier to transport and preserve. Similarly, they could also be used to intensify the frequency of plantations, reduce rice cultivations' greenhouse gas emissions, enhance the photosynthesis of seaweed and plants, and, consequently, their ability to absorb carbonic dioxide (Giddings, Rozansky, and Hart, 2020). In order to reduce the emission of greenhouse gases (in particular, methane) produced by rearing, we could instead intensify aquaculture (fish breeding) or genetically modify micro-organisms causing the emission of these gases in the animals bred. Similarly, another solution is to alter the animals genetically so as to reduce the presence of these micro-organisms (Giddings, Rozansky, and Hart, 2020; de Graeff, Jongsma, Johnston, Hartley and Bredenoord, 2018).

As far as human beings are concerned, genome editing interventions could be used to reduce their impact on the environment or to enhance them, that is, to morally improve them. The first objective could be achieved by, for example, making future generations intolerant to animal meat; this would likewise permit reducing or stopping animal rearing. They can also be modified to be born with a smaller body (shorter, for example), or, without changing their body, significantly reducing their individual need for water and food (Liao Sandberg & Roache, 2012, pp. 206–221). Human beings are also currently incapable of photosynthesis, that is, to turn carbon dioxide into glucose. However, it is plausible to say that society would not change much if we had this ability. Moreover, we might still not obtain sufficient calories through this process, thus requiring more traditional means of caloric intake.

Further, greater resistance to heat and tropical diseases might also permit human beings to (live or) survive in the eventuality of a significant rise in average temperature (Lehmann, 2017, pp. 1186–1192), while the ability to see in the dark, like cats, would reduce energy consumption. Still, for Persson and Savulescu (2012), moral bio-enhancement (improving our dispositions through biomedical technology) is the best

way to face the environmental crisis given that we have developed a functional moral sensitivity to cooperate within highly restricted groups, not to face inter-generational problems (like the current ones). Only through enhancing cognitive skills, but especially empathy – say Persson and Savulescu – may we overcome our *natural* partiality towards closer people and see things from a steadier, more general (or impartial point of view). Moreover, cognitive enhancement may allow us to control our emotions more firmly. Still, only enhancement of empathy can make us more altruistic towards those further away: enhancing empathy would also be a more direct means of bio-enhancement, while a cognitive enhancement would not immediately change our behaviour and feelings.

We shall leave aside the questions emerging from genetically modifying nature (plants and animals) and only turn our attention to interventions regarding humans. Suppose it is true that the problems currently afflicting humanity could be addressed more efficiently by using new technologies (particularly taking recourse to genome editing). In that case, it is worth asking if there is anything wrong with genetically modifying future people. After having reconstructed the main principled moral objections that have been advanced against the modification of our genetic code, we will maintain that the genetic modification of future generations may be morally justified if it contributes to promoting the interests (both subjective and objective) of those involved. The fact that the genetic modification intervention is not therapeutic is morally irrelevant, given that we have no duty to preserve the human condition (including the genetic one) in its current state. The reasons we shall still put forward in favour of genetically modifying future generations also justify that of plants and non-human animals: as far as animals are concerned, the problem is not the genetic changes, but the suffering we cause to them through practices of exploitation and instrumentalisation.

The safety of genome editing interventions on embryos is still an open question. A great deal of the scientific community considers that it would not be morally responsible to practise these interventions today, given that the risk of causing severe genetic anomalies in those yet to be born would still be high (intervention could cause off-target genetic modifications or modify all the embryo cells). Still, we do not need to dwell on this specific problem. Instead, we will reflect on the moral acceptability of genome editing interventions, thus limiting our analysis only to matters of principle. Accordingly, we move from the hypothesis that they may one day become sufficiently safe for those involved.

### **3. Arguments Against the Genetic Enhancement or Replanning of Human Beings**

Even if genome editing interventions seem to offer a way out of the problems emerging with climate change, the plan to modify the next generations raises quite a little resistance. For this reason, before explaining why it is not wrong to put people with a modified genome into the world, it may be helpful to refer to the works of Francis Fukuyama, Michael Sandel and Jurgen Habermas, as this will allow us to rebuild the main moral objections to these interventions.

According to Francis Fukuyama (2002), it is true that it is not easy to contest the value of biotechnology and genetically replanning human beings presents an undeniable potential. Still, important objections of a religious, utilitarian, and philosophical character may be put forward. From a religious point of view, any project to replan humanity would be the expression of a lack of respect towards God (and His will). With genome editing, human beings would replace God in the choice of creating human life (Fukuyama 2002, 89). Furthermore, the willingness to modify human nature may only arise from an inability to recognise human beings as a wonder of divine creation and expression of God's will. Genetic engineering presupposes a conception of human life 'as the sum of a series of material causes that human beings can understand and manipulate. All of this fails to respect human dignity, and thus violates God's will' (Fukuyama 2002, 89). And regardless of the arguments of a religious nature, any intervention to enhance or replan humanity could run up against unexpected costs, and, in any case, the long-term negative consequences could outweigh the alleged immediate benefits. According to Fukuyama, when we reflect on bio-technologies, we are never impartial judges. We turn our attention exclusively to the advantages they promise (for example, far longer life and improved physical, cognitive dispositions and abilities).

Consequently, we tend to lose sight of (and are unable to consider) the possible consequences on a personal and social level (for example, more social tension, life with greater suffering, and a limitation on autonomy). The highest cost would—and according to Fukuyama, this is the philosophical objection—be the difficulty in continuing to recognise a human being's worthiness of dignity, moral relevance, and rights. Besides, human nature would be the basis for our rights, so that any intervention modifying it in its genetic heritage threatens;

our humanity—that is, some essential quality that has always underpinned our sense of who we are and where we are going, despite all of the evident changes that have taken place in the human condition through the course of history (Fukuyama, 2002, p. 101).

We could also not perceive – Fukuyama states – that a fundamental ontological change has taken place. Still, we would lose something giving value to our lives. We could “emerge on the other side of a great divide between human and posthuman history and not even see that the watershed had been breached because we lost sight of what that essence was” (Fukuyama, 2002, p. 101). Accordingly, for Fukuyama, an overall judgement of the new biotechnologies and the plan to redesign our human nature (based on our needs and preferences) may not be based only on a utilitarian calculation of the costs and benefits we can derive from there. Still, it must also consider the (maybe irreversible) loss of our moral skills and – adds Fukuyama – our very ability to clearly distinguish good from evil:

It may be the case that, as Nietzsche predicted, we are fated to move beyond this moral sense. But if so, we need to accept the consequences of the abandonment of natural standards for right and wrong forthrightly and recognise, as Nietzsche did, that this may lead us into territory that many of us don't want to visit. To survey this terra

incognita, however, we need to understand modern theories of rights and what role human nature plays in our political order (Fukuyama, 2002, p. 102).

However, while for Fukuyama, replanning a human is incompatible with human rights (that is, genome editing interventions put the very basis of our moral sense at risk), this is not so according to Michael Sandel (2007). Sandel argues that enhancement (or at least modifying human nature) is morally dubious because it would not only be the expression of a morally vicious character (which is no longer able to consider human life as a gift) but also because it would compromise our character, having a bad influence on our natural moral dispositions. First and foremost, the problem – Sandel states – is the Promethean aspiration to redesign nature, including human nature, so that it serves our ends and satisfies our wishes because it gives away an inability to appreciate the abilities and dispositions nature produces. In Sandel's own words: “the problem is not the drift to mechanism but the drive to mastery. And what the drive to mastery misses, and may even destroy is an appreciation of the gifted character of human powers and achievement” (Sandel, 2007, p. 27). Overall, for Sandel, a virtuous person would have the ability to recognise that not everything in the world is at our disposal and/or can be used as we wish. That is, they would be capable of a humble (and respectful) attitude towards nature. Only when this sensitivity—which, according to Sandel, should not be reduced to religious sensitivity—is lost, may the desire or rather the project to replan human nature arise: “An appreciation of the giftedness of life constrains the Promethean project and conduces to a certain humility. It is, in part, a religious sensibility. But its resonance reaches beyond religion” (Sandel, 2007, p. 27).

Further, for Sandel, turning to genome editing intervention (is an expression of and) encourages seeing one's children as not a gift but as an object or a product. Besides, parents should love their children only for what they are (and not because they have certain genetic features allowing them to express specific talents). However, anyone wishing to enhance (or at least programme) their children's genetic heritage would lack both this openness to the unexpected and the ability to love unconditionally, in that they would display the need to control (and dominate) the mystery of life (Sandel, 2007, pp. 46–47). In these terms, Sandel (2007, p. 85) writes, genome editing interventions would represent the triumph of willingness over giftedness: “of dominion over reverence, of moulding over beholding”: the result may only be a loss in our humanity and moral features. We do not only risk to lose respect towards nature, but also to considering ourselves as self-sufficient, thinking we no longer have a common destiny with our peers, and ultimately believing (or convincing ourselves) we no longer owe other people anything. If, says Sandel (2007, p. 86)—“the genetic revolution erodes our appreciation for the gifted character of human powers and achievements, it will transform three key features of our moral landscape: humility, responsibility and solidarity”.

Jurgen Habermas (2013) adds further emphasis to these criticisms towards genome editing. In his opinion, turning to genome editing for purposes of improvement (or of replanning humans) would mark the transformation of the person born into an object or product. That is, enhancing or replanning humans

would be an intrinsically instrumental practice, in that the genetic planner imposes his designs onto another person, thus treating them as we generally treat the objects we build and use. Further, the person coming into the world would undergo severe limitations on autonomy and could also have problems feeling like the artificer or main character in their life. But, again, this is because they would be born with a genetic code chosen by other people:

Post factum knowledge of this circumstance may intervene in the self-relation of the person, the relation to her bodily or mental existence. The change would take place in the mind. Awareness would shift as a consequence of this change of perspective, from the performative attitude of a first person living her own life to the observer perspective which governed the intervention one's own body was subjected to before birth. (Habermas, 2003, p. 53)

After all, writes Habermas, for the genetically modified person (that is, one whose genome has been planned by the parents), it would be impossible to identify and feel at one with their own body, given that this body would no longer be something naturally unavailable:

The body is the medium for incarnating the personal mode of existence in such a way that any kind of self-reference, as for instance first person sentences, is not only unnecessary, but meaningless. It is the body that our sense of direction refers to, denoting center and periphery, the own and the alien. (...) And for the person to feel one with her body, it seems that this body has to be experienced as something natural – as a continuation of the organic, self-regenerative life from which the person was born. (Habermas, 2003, pp. 57–58)

Finally, according to Habermas, the instrumental character of the genetic enhancement procedure would be incompatible with the constitutional principles of a liberal-democratic society, in that reducing the person to be born into an object constitutes a negation of their dignity. Besides, the person born would irreversibly depend on their genetic planner, in that they could no longer change the genetic modifications received at birth. For this reason, the person born with an enhanced (or programmed) genetic heritage would live through a worse condition than that of a slave, in that, unlike the slave, they could not hope to regain their freedom one day:

Rather, the adult would remain blindly dependent on the non-revisable decision of another person, without any opportunity to establish the symmetrical responsibility required if one is to enter into a retroactive ethical self-reflection as a process among peers. For this poor soul there are only two alternatives, fatalism and resentment. (Habermas 2003, 14)

#### 4. Is it Right to Address Climate Change by Modifying Future Generations?

It has been stated that the programmes to replan human nature could be highly risky in that they may have unpredictable consequences or compromise people's health. For example, a programme to enhance empathy might reinforce partiality for the people of their family or a restricted community instead of promoting altruism. Moreover, altruism is appreciable, but unless accompanied by an adequate moral sensitivity, it can drive one to sacrifice anything or energy to the advantage of other people and consequently turn into indifference or insensitivity towards those who love us. In the same way, reducing aggressiveness is desirable in particular situations. Still, when it becomes an inability to react or respond to wrong-doing and injustice, it risks becoming a severe vice, in that it can make one utterly indifferent to the suffering of other people. Shorter people (even by just a few centimetres), then, would consume fewer resources, but reducing height may cause—among other things—a rise in weight, loss of fertility, and gastrointestinal and cognitive problems (Zwarthoed, 2014, p. 88). I also believe it would be irresponsible to implement a genetic modification programme without considering the possible consequences for the people involved. Reflecting on the morality of interventions genetically *replanning* human nature as a tool to face climate change and the environmental crisis, we can only start from the hypothesis that these interventions are safe (i.e., that they have no side effects—for example, off-target genetic modifications—and further long-term negative consequences) and do not produce negative consequences for society by worsening the condition of the living beings. I do not intend to get involved in defending particular examples of the genetic replanning of human nature, but simply state that—alongside different solutions, like changing one's lifestyle and behaviour and supporting the green economy—we should also consider the advantages of turning to genetic reprogramming interventions.

Suppose some objections against enhancing (or replanning) humans seem convincing to us (and so seem to justify some of our worries). In that case, it is only because the debate on human enhancement tends to substitute arguments with rhetoric. The positions of Fukuyama and Sandel may be the best example of this tendency. For Fukuyama, replanning humans would be incompatible with human rights in that it would forever jeopardise what constitutes the essence of the human being:

And what is that human essence that we might be in danger of losing? (...) it would have to do with human nature: the species-typical characteristics shared by all human beings qua human beings. That is ultimately what is at stake in the biotech revolution. (Fukuyama, 2002, p. 101)

Yet it is not clear what this distinguishing feature characterising us as *human beings* would be and in what way biotechnologies could jeopardise it. Any attempt to define it, as Jonathan Glover states (2006, pp. 81–85), risks being arbitrary and linked more to our prejudices or habits than to an objective evaluation of things. Thus, for example, Glover (2006, p. 84) states that before the development of new

reproductive techniques, being born from one's own mother may have seemed an essential characteristic of the human being: but who would now state that children born of a surrogate mother are not human beings?

In the same way, some of our features (for example, a relatively brief life, physical and cognitive abilities that are limited or at least destined to wear off over time) may seem elements constituting our humanity. Still, they may appear different to people born with abilities and dispositions that are *reprogrammed* due to genome editing interventions. Moreover, not only is the meaning of essential not obvious, but something may be an essential feature of our humanity, but lack value or not be worth preserving. Otherwise, we would have to think that we lose something vital if we become less aggressive or no longer enjoy planning and engaging in cruel behaviour. Fukuyama also thinks that the replanning interventions would make us less human because—if we had other features—it would be more challenging to think that we belong to the human species. However, it is debatable whether a programme to enhance or replan humans—i.e., to modify or enhance our dispositions through genome editing interventions—is capable of jeopardising or compromising human nature forever. Human nature is not immutable; it changes over time (throughout evolution). Anyone stating the opposite adopts a pre-Darwinian conception of the world (Buchanan, 2011, pp. 6-7). But even if we admitted that any genetic modification programme would jeopardise our humanity and not allow us to recognise ourselves as human anymore, Fukuyama's worry regarding the consequences for morality, i.e., the impossibility of identifying the same rights for people who do not have human nature, appears unjustified. This is because belonging to the species is not a necessary nor sufficient condition for having dignity. Apart from this, it would be absurd to think that—at times of genome editing—some people could be discriminated against only because they display above-average abilities and dispositions (for example, more acute sight or intelligence, greater resistance to tiredness or a longer life) or simply features that are more compatible with safeguarding nature and ecological balance.

Furthermore, Sandel's recommendation of conserving—especially in choices regarding the birth and placement in the world of other people—an open attitude to the unexpected and cultivating a disposition towards humility and respect towards the mystery of life appears incompatible with any ethics of responsibility. This is because it seems like an invitation to abandon oneself to chance. In his reflections on human enhancement, Sandel intends to consider things from a rational perspective, independently of any belief in the existence of a creating divinity:

I argue, to the contrary, that an appreciation for the giftedness of life can arise from either religious or secular sources. While some believe that God is the source of the gift of life, and that reverence for life is a form of gratitude to God, one need not hold this belief in order to appreciate life as a gift or to have reverence for it. (...) In a similar way, people often speak of the sanctity of life, and even of nature, without necessarily embracing the strong metaphysical version of that idea. (Sandel, 2007, 93)

However, it seems evident that the value of trusting in chance (and giving up choice) may only seem sustainable within a metaphysical conception of the world in which God governs nature and—if left to run its course—will always favour our good. The fact that Sandel (implicitly) refers to a religious perspective drains all strength from his criticism towards human enhancement and any replanning of humans, in that his moral arguments cannot claim to have universal validity (that is, they may only be accepted by those defending his very perspective). That is, if we put aside a religious perspective and consider things rationally, it does not seem reasonable to give up any modification of human nature so as to cultivate a disposition to humility towards nature and respect towards life. Indeed, even if we cultivate a feeling of respect towards nature as a good thing, turning to biotechnologies (and to enhancement interventions) could promote equally important good things (for example, longer life or greater ability to preserve natural resources). Sandel worries that the impulse to cancel the contingent and master the mystery of life may compromise the parent's ability to love their child unconditionally: "Even if it does not harm the child or impair its autonomy, eugenic parenting is objectionable because it expresses and entrenches a certain stance toward the world—a stance of mastery and dominion" (Sandel, 2007, p. 83), that is, an attitude that is unable to appreciate life as a gift. However, it is not right to interpret the fact that a parent worries about the genetic information of the child to be born as a sign of their inability to love their child unconditionally. A parent choosing to turn to genome editing interventions and modify their children's genetic heritage may have legitimate worries over their wellbeing and the life they will have to face in an increasingly competitive society with less and less solidarity.

Moreover—as Allen Buchanan reminds us—it is possible to cultivate a feeling of respect towards nature and/or consider life as a gift even when enjoying enhanced abilities (or coming into the world with a genetically modified or improved heritage): "Opportunities for a sense of 'giftedness' would not be lacking in a world replete with biomedical enhancement" (Buchanan, 2011, p. 81). In other terms, lowering giftedness would still not jeopardise giftedness, in that it is not true that 'there would be nothing left to affirm or behold outside our own will' (Buchanan, 2011, p. 81). One may also admit that excessive worry over improvement may not allow us to recognise the things we have appropriately: but sometimes making do with existing things means giving up on improvement and, at other times, change may be the only way to preserve or value existing things.

Habermas worries that a genetically modified child may still feel less independent because their genetic heritage is not the result of chance—of a natural recombination of the gametes' genetic heritage—but of another person's programming. A person born with a modified (that is, programmed) genetic heritage could actually gain the impression that they no longer had a chance of "being-able-to-be-oneself" (Habermas, 2003, pp. 56–60) and were, then, more similar to an object-product than a person. In other terms, the intervention could turn out to be like a factor disturbing their life, in that the process of genetic modification would forever condition their self-understanding:

Shifting the “line between chance and choice” affects the self-understanding of persons who act on moral grounds and are concerned about their life as a whole. It makes us aware of the inter-relations between our self-understanding as moral beings and the anthropological background of an ethics of the species. (Habermas, 2003, pp. 28–29)

However, the mistake is to think that a person can have a life (or existence) that is not marked by conditioning affecting personality and behaviour. The point is not only that any person’s life is conditioned by the genetic code they possess: if a non-chosen genetic code limited autonomy (or hindered “being-able-to-be-oneself”), then any individual would be deprived from birth of an *authentic* life. The fact is also that we can feel we are the artificers (or rather, the *main characters*) of our destiny even when we know that our life is the result of the genetic heritage we have received, the context in which we are born, the education they have taught us and our experiences. For what reason, then, should possible genetic modification or programming jeopardise our perception as free subjects responsible for our actions? Habermas is convinced that genetic modification or programming makes the unborn child healthy, in that their identity and character would be fixed once and for all (by the parents’ choice to pass *particular* genes rather than other ones to their children). But this is not true, in that the genetic code can play even a significant role, but our identity and character then depend on a series of factors, including the subject’s willingness and ability to mould their own life. It would be ingenuous to think that our disposition could be programmed genetically and that it may take shape without the need for any effort or choice by the subject. That is, tomorrow, thanks to the new (bio-)technologies that will permit modification of the genetic code, future generations may perform certain activities with (far) more ease, but their actions would not slide off them like something external they can only contemplate. However, we do not need to rule out the possibility that the genetic modification (or programming) intervention jeopardises the “sense of independence” of the person born. In fact, in life, independence—as Glover reminds us (2006, p. 72)—is not the only important thing, and it could be reasonable to barter at least a part of one’s parents’ independence in exchange for advantages, in terms of opportunity and freedom, which can be obtained from genetic programming. Imagine, for example, that our parents could have chosen (with a simple intervention modifying the genome on the embryo whence we have been developed) and ensured us with the chance to live positive life experiences more intensely or be freer to determine ourselves. In this case, many of us would be happy to lose some of our independence: “For a richer life, or for a greater ability to invent ourselves and our lives, some loss of independence is a price that may be worth paying” (Glover, 2006, p. 72). It seems even more evident if we think that turning to genetic modification interventions is designed not to enhance our abilities or dispositions but to put us in a position to worry more about future generations or at least damage the environment less. In fact, in this case, losing some independence would seem to be amply made up for by the benefits that could be ensured to a great deal of people.

## **5. Space Travel and a Not Enhancement-based Redesign of Human Nature**

We are increasingly aware that we risk leaving to ‘future generations’ a planet that cannot be lived on. Demographic growth, pollution, reduction in natural resources, and climate change may have dramatic consequences on the quality of life for those coming after us (Edwards, 2021a, 2021b; Kovic, 2021). To guarantee a better future for our species, it is necessary to change our behaviour. It is possible that our psychology and moral sensitivity are not adequate for facing the problems currently emerging from our new living conditions. Unprecedented demographic growth and—as Persson and Savulescu (2012) remind us—technological development permits us to have global impacts that stretch into the distant future. In the light of these difficulties, it has been stated that traditional methods such as moral education and social reform, among others, are no longer sufficient resources for solving the environmental crisis. We should consider the advantages of turning to genetic reprogramming interventions. Genome editing interventions could indeed make human beings far more sensitive to the interests and wellbeing of future generations and help them implement behaviours that do not have negative effects on the environment and delicate ecological balances. In this chapter, I have considered the main objections to this suggestion, and my conclusion is that turning to genome editing may be morally justified, not only to correct or prevent significant diseases or disturbances of a genetic nature but also to enhance or at least replan the features of future generations. We have no reason to preserve the current psycho-physical features of the human species. If it is true that living species do not have a fixed (that is, immutable) essence, we can approve any genetic modification promoting overall wellbeing.

We have thus far considered the possibility of turning to interventions modifying (and replanning human nature) as an instrument that may serve to face and solve the environmental crisis. In this case, replanning human nature may take the form of morally improving (that is, making future generations more empathetic and so able to pay attention to the long-term consequences of their actions) or take the form of disempowerment. We can, that is, choose to focus on radical replanning that increases our abilities, or we can opt to diminish these abilities. Overcoming the human (and so a posthuman) in a direction that diminishes his natural abilities or disposition may seem dubious but does not appear intrinsically immoral. On the contrary, the risk that the human species may encounter (mass) extinction tomorrow could make such a project morally acceptable and even mandatory. Yet we can not only imagine scenarios in which overcoming the current human condition may be a morally acceptable or even imperative plan, even if it does not involve any enhancement of our skills or dispositions; we can also believe that replanning the human race (without improving or enhancing our abilities) may be a more desirable objective than any plan permitting the (bio)enhancement of human skills and dispositions. For us, the fact that replanning human nature (that does not pass for enhancing human skills) may seem like a more desirable objective than any enhancement resizes the value transhumanists attribute to the bio-enhancement plan.

Space travel offers an excellent example of what it means to talk of a replanning of human nature that 1) does not necessarily imply improving or enhancing abilities and 2) may be a more desirable objective than any enhancement. Space travel may concern our solar system or other ones. Any plan for space travel in our solar system (involving the launch of a process to colonise and consequently build permanent settlements on other planets) must consider the human body's inability to survive in *space* (Campa, 2020; Szocik, 2021, 2019). The development of increasingly advanced technologies able to protect us from, for example, sun radiation hundreds of times superior to those we have to bear on Earth and from very different climate conditions from those we are used to may offer a temporary solution, but to build permanent settlements on other planets, we have only two possibilities (Balistreri & Umbrello, 2022b). The first is to turn to geoengineering interventions able to change radically the environmental conditions of the planet we wish to colonise and make it similar to the Earth. The other is to radically replan human nature and allow the survival of human beings (and animals) even in environments quite unlike the Earth (Balistreri & Umbrello, 2022c; Szocik & Braddock, 2019). Arguments in favour of both the first solution (changing the environment) and the other (i.e., changing human nature) may be advanced. This is why it is legitimate to believe that the question should be faced case by case, without referring to absolute principles or perspectives (Balistreri & Umbrello, 2022a). One could, however, imagine that in some cases replanning human nature may appear to be the preferable solution regarding any replanning of environmental conditions, in that this intervention is less invasive and more straightforward but also less expensive.

Furthermore, replanning human nature through genome editing interventions may be performed in quite a limited time (although we cannot calculate how long it will be before the modified people can leave for space, the intervention should still be effective over the course of their life; otherwise, it would be useless), while it could be imagined that any replanning of the environment would require decades, if not centuries. It may then be reasonably stated that space travel and plans to colonise other planets encourage the creation of this new man so dear to transhumanists. Yet what emerges is that this man is not necessarily a *better* one. There are differences, explains Sorgner, on how transhumanists conceive of the post-human, in that post-human may designate both a species apart and the completion of a path which—passing for current humanity—then permits first the temporary, and then the definitive overcoming of man. Yet within transhumanism there is broad convergence on the desirability, and in part the necessity, of bringing about a new man, with characteristics that are not only more original than those we know but broadly superior to the maximum that any human being may attain without turning to new technological tools (Sorgner, 2021, 2016/2020). So for Sorgner, planning the new man necessarily implies enhancement, in that the post-human incarnates human characteristics at an increasingly elevated or superior level. Yet thought on space travel and colonising other planets demonstrates that it is possible to imagine the desirability of an overcoming of man (and consequently the planning of the post-human) that does not pass for an enhancement or improvement of his characteristics. That is, even forms of human replanning (and consequently post-human planning)

that are not based on enhancing our abilities may have value (and also be for us more important objectives than any enhancement of our abilities). I do not by this intend to maintain that improving cognitive abilities (intelligence, memory, promptness of reflexes) and empathy may not serve in an extra-terrestrial scenario (Garasic, 2021, 2022; Balistreri & Umbrello, 2022b). What I wish to state is that when we think of space travel (and the possibility of building new settlements in space stations or on other planets), we can imagine scenarios in which what counts is not so much improving *natural* human abilities as planning that allows human beings to explore the hitherto inaccessible territory. And this opens the door to the possibility of also thinking of the posthuman in ways completely different to (and more original than) how we are used to thinking of and portraying it and, above all—taking Sorgner’s reconstruction into account—the transhumanists tend to describe it.

In the previous pages, we have thought about human replanning as the ideal solution (or last resort) in facing an environmental crisis that otherwise risks leading us to extinction. It could then be believed that possible human disempowerment (or at least replanning the human in non-bio-enhancement terms) may only be morally acceptable in exceptional conditions when we have no better alternatives, whilst in normal or ordinary situations, the only morally acceptable form of human replanning is the one involving the improvement or enhancement of our dispositions. Yet it is not difficult to imagine situations in which we may have important reasons to implement replanning human nature (without necessarily implying enhancing our abilities or dispositions) even if our survival is not at all at risk (and we are not dealing with a less and less hospitable planet). For example, let’s think of travel in space or to other planets (Ferrando, 2016). We can easily imagine that some people could agree to participate in a space mission involving an extended stay in space (or even a definitive move to another planet) simply due to a desire to explore the uncontaminated territory and put their courage to the test (Balistreri, 2022). This is, for example, why Patrick Lin (2006) believes that, when we think of space travel, it is difficult to think that we could substitute astronauts with increasingly intelligent machines. We can also imagine increasingly intelligent machines able to explore the universe and gather any information or knowledge on our solar system and other planets: the problem is that we wish to refrain from delegating to machines the type of experience in play here. Despite the ethical, political, and economic challenges in exploring and settling space, there are – Lin states – good reasons for the endeavor. Wanderlust, or the compelling need to explore or travel to new places, is in our DNA—that is simply what humans do. Call it the indefatigable, and arguably incorrigible, “human spirit” to push our physical, intellectual, and creative boundaries. In this section, however, we will take a critical look at these reasons to explore new worlds, since finding a moral imperative or justification for such a venture in the first place must be a fundamental part of space ethics (Lin 2006). That is, when we think of space travel, we tend to believe that it is only for knowledge: it is not, then, but a means that serves to reach a specific objective (where, we mean, the end and only the end counts, whatever the instrument or means we use). Were it so, not only could we could utilise machines for our space travel, but the use of

increasingly intelligent machines (or robots) would be the most reasonable choice, in that, as Keith Abney writes

robots are already simply better, cheaper, and faster than humans, and their advantage will only increase over time. Their sensors are more reliable, their memories have far greater capacity and are less prone to error, and they can operate in environmental conditions humans would never dare venture into, with far fewer ethical constraints regarding self- and other-preservation when they do. (Abney, 2017, p. 357)

The point is that we probably seek not only information or knowledge in space travel but the opportunity to have a type of experience that is important to us. To gain this experience, some people may prefer a kind of modification in human nature that allows them to travel in space for an extended period or permanently (or to survive on other planets) over any available form of enhancement. Enhancing abilities and dispositions are not *naturally* incompatible with missions, but one leaving for space may need or prefer original features, which does not mean improving or enhancing our features.

It could be stated that enhancing human abilities and dispositions may also be valuable for those choosing to develop original features that do not, in the least, mean improving or enhancing our features. The point is that one can imagine scenarios in which the choice is necessarily exclusive, in the sense that opting for original features precludes enhancing one's own characteristics. For example, genome editing-based enhancement interventions could be technically incompatible with other genetic modification interventions. Or some forms of enhancement could have a negative relapse for additional features, such as reducing or cancelling the modified subject's possibility of expressing them. Further, when we think of space travel, we may also imagine situations in which the choice to participate in certain long-term or lifelong space missions might forever preclude the possibility of enhancing one's own, natural abilities or dispositions. Think, for example, of a generation ship, that is, that type of interstellar spaceship able to travel at a speed equal or inferior to that of light, designed to host generations of human beings for a space mission lasting a long time, even centuries (Umbrello & Balistreri, 2022; Levy, 2016; Hein et al., 2012). People starting this travel and those who will then be born over time may need to modify some of their characteristics so as not to have problems and to survive in space not for a short period, but for their whole life. It is no contradiction (or logical error) to imagine that these changes do not mean improvement, but only allow those involved to survive: for this reason, we could even describe them as interventions that are for therapy rather than improvement. It seems evident to us that people choosing to face this space travel (or mission) in the knowledge that they will no longer have the possibility of returning to the Earth one day, taking into account that—travelling in the generation ship—they will probably no longer be able to access those improvement medicine interventions that will in the meantime be developed on our planet. For example, the connection between the generation ship and the Earth might fail or become unstable, or it may simply be impossible to reproduce the results reached on the Earth on the ship because there are no technologies or scarce

resources to practise this type of intervention. But even if we imagine this scenario, there seems nothing morally dubious to us in the fact that the people choose to participate in adventurous space travel in a generation ship rather than enhancing their dispositions. For us, this means that transhumanists are wrong, and it is not right that the only morally acceptable form of human redesign is that which passes for enhancing abilities and dispositions.

## 6. Conclusion

Scientific and technological development now allows us to enjoy instruments with which we can not only modify our environment but also replan, radically if we wish, human nature. Transhumanists maintain that it is our task (or instead, responsibility) to promote the birth of the post-human, that is, a human individual with cognitive and physical abilities and dispositions superior to and surpassing what we can at the moment only imagine. Such a plan would not serve to prevent or cure disease, so its purpose would not be therapeutic, but this does not mean that it may not be morally acceptable. Indeed, if we consider the use of biotechnologies for therapeutic purposes approvable, then we should all the more accept (or evaluate as obligatory) the use of these very technologies for the purposes of improvement, in that, at times, we can only improve our life through (bio)enhancement. Yet we do not believe that enhancement is the only acceptable form of human replanning. We have considered the environmental emergence and the possibility of employing new genetic modification technologies to allow space travel and exploration. In both cases, replanning human nature may be morally justified even if it does not enhance human abilities or dispositions. So in connecting the “post-human plan” with the desirability, and in part (with) the necessity of enhancing human nature, the transhumanists seem not to go beyond the classic image of the human in that they strongly reassert the importance and value of their characteristics. The human being is to be surpassed, but their essence (i.e., characteristics) is preserved. We believe that a post-human plan should have the courage to move the human further and open the door to the possibility of a replanning, unlike the one we can currently imagine.

## References

- Abney, K. (2017). Robots and space ethics. In P. Lin, K. Abney and R. Jenkins (Eds.), *Robot ethics 2.0: From autonomous cars to Artificial Intelligence* (pp. 354–368). Oxford University Press.
- Balistreri, M. (2022). *Il Bambino migliore?* Fandango.
- Balistreri, M. (2022). I viaggi nello spazio dovrebbero essere umani o robotici? Ragioni a favore e contro l'automazione completa per le missioni spaziali. In M. Balistreri & P. Marrone, *Utopie dell'automazione completa* (pp. 17–36). Mimesis.
- Balistreri, M., & Umbrello, S. (2022a). Should the colonisation of space be based on reproduction? Critical considerations on the choice of having a child in space. *Journal of Responsible Technology*, 11. <https://doi.org/10.1016/j.jrt.2022.100040>

- Balistreri, M., & Umbrello, S. (2022b). Space travel does not constitute a condition of morale exceptionality. That which obtains in space obtains also on Earth! *Medicina & Morale*, 71(3), 311–321.
- Balistreri, M., & Umbrello, S. (2022c). *Modifying the environment or human nature? What is the right choice for space travel and Mars colonisation?* Working paper.
- Bostrom, N. (2009). Why I want to be a posthuman when I grow up. In B. Gordijn & R. Chadwick (Eds.), *Medical enhancement and posthumanity* (pp. 107–136). Springer.
- Brock, D. W. (2005). Shaping future children: parental rights and societal interests. *The Journal of Political Philosophy*, 13(4), 377–398. <https://doi.org/10.1111/j.1467-9760.2005.00229.x>
- Buchanan, A. (2011). *Beyond humanity?* Oxford University Press.
- Campa, R. (2020). Anti-Aging medicine as a game changer for long-lasting space missions. In K. Szocik (Eds.), *Human enhancements for space missions. Space and Society* (pp. 129-148). Springer. [https://doi.org/10.1007/978-3-030-42036-9\\_10](https://doi.org/10.1007/978-3-030-42036-9_10)
- Dworkin, R. (1994). *Life's dominion: an argument about abortion, euthanasia, and individual freedom*. Vintage.
- Edwards, M.R. (2021a). Android Noahs and embryo Arks: Ectogenesis in global catastrophe survival and space colonization. *International Journal of Astrobiology*, 20, 150–158.
- Edwards, M.R. (2021b). Ectogenesis for survival in deep space and deep time: Reply to Gale and Wandel. *International Journal of Astrobiology*, 20, 252– 253.
- Ferrando, F. (2016). Why space migration must be posthuman. In J. Schwartz & T. Milligan, (Eds.), *The ethics of Space*, (Vol. 8) (pp. 137–152). Springer.
- Fox, D. (2007). The illiberality of 'liberal eugenics'. *Ratio*, 20(1), 1–25.
- Fukuyama, F. (2003). *Our posthuman future. Consequences of the biotechnology revolution*. Farrar, Straus and Giroux.
- Garasic, M. (2021). The war of ethical worlds: why an acceptance of post-humanism on Mars does not imply a follow-up on Earth. *Medicina e Morale*, 70(3), 317–327.
- Garasic, M. (2022). What happens on Mars, stays on Mars: A reply to Balistreri and Umbrello. *Medicina e Morale*, 71(3), 323–332.
- Giddings Val L., Rozansky, R., Hart, D. M. (September 2020). Gene editing for the climate: biological solutions for curbing greenhouse emissions. *Information Technology & Innovation Foundation*. 1–39. <https://itif.org/publications/2020/09/14/gene-editing-climate-biological-solutions-curbing-greenhouse-emissions>
- Glover, J. (2006). *Choosing children. Genes, disability, and design*. Oxford University Press.
- de Graeff N., Jongsma, K. R., Johnston, J., Hartley, S., Bredenoord A. L. (2018). The ethics of genome editing in non-human animals: a systematic review of reasons reported in the academic literature. *Phil. Trans. R. Soc. B*, 374, 1–25. <https://doi.org/10.1098/rstb.2018.0106>
- Habermas, J. (2013). *The future of human nature*. Polity Press.
- Hein, A. M., Pak, M., Pütz, D., Bühler, C., & Reiss, P. (2012). World ships—architectures & feasibility revisited. *Journal of the British Interplanetary Society*, 65(4), 119–133.
- Intergovernmental Panel on Climate Change (IPCC). (2018). *Global warming of 1.5 (special report)*.

- Intergovernmental Panel on Climate Change (IPCC). (2021). *Climate change: the physical science basis (sixth assessment report)*.
- Kovic M. (2021). Risks of space colonization. *Futures*, 126.
- Lehmann, L. S. (2017). Is editing the genome for climate change adaptation ethically justifiable?" *AMA Journal of Ethics*, 19(12) 1186–1192. <https://doi.org/10.1001/journalofethics.2017.19.12.stas1-1712>
- Levy, N. (Retrieved November 18, 2022). Would it be immoral to send out a generation starship?. *Aeon*. from <https://aeon.co/ideas/would-it-be-immoral-to-send-out-a-generation-starship>. (Original work published 2016).
- Liao, M., Sandberg, A. & Roache, R. (2012). Human engineering and climate change. *Ethics, Policy and Environment*, 15(2), 206–221. <https://doi.org/10.1080/21550085.2012.685574>
- Liao, M. (2017). Tackling climate change through human engineering. In A. De Grey, J. Rossiter, J.A. Paradiso, K. Warwick, H. Shah (Eds.), *The next step: Exponential life* (pp. 274–293). BBVA.
- Lin, P. (2006). Space ethics: Look before taking another leap for mankind. *Astropolitics*, 4 (3) 281–94.
- Persson, I., Savulescu, J. (2012). *Unfit for the future. The need of moral enhancement*. Oxford University Press.
- Sandel, M. (2007). *The case against perfection. Ethics in the age of genetic engineering*. Harvard University Press.
- Sorgner, S. L. (2020). *On Transhumanism: The most dangerous idea in the world?! (S. Hawkins, Trans)*. Pennsylvania State University Press. (Original work published 2016).
- Sorgner, S. L. (2022). *We have always been cyborgs: Digital Data, Gene Technologies, and an Ethics of Transhumanism*. Bristol University Press.
- Szocik, K. (2019). Is human enhancement in space a moral duty? Missions to Mars, advanced AI and genome editing in space. *Cambridge Quarterly of Healthcare Ethics*, 29, 122–130.
- Szocik, K. & Braddock, M. (2019). Why human enhancement is necessary for successful human deep-space missions, *The New Bioethics*, 25(4), 295–317.
- Szocik, K. (2021). Humanity should colonize space in order to survive but not with embryo space colonization. *International Journal of Astrobiology*, 20, 319–322.
- Thaler, R. H. & Sunstein, C. R. (2008). *Nudge: improving decisions about health, wealth, and happiness*. Yale University Press.
- Umbrello, S. & Balistreri, M. Human enhancement and reproductive ethics on generation ships. *Argumenta*, forthcoming.
- Zwarthoed, D. (2014). On the limited appeal of human engineering as a response to climate change. *Bioethica Forum*, 7(3), 87–89.