

Altering the Code of Life: Are We Crossing a Line?

In 2025, the tobacco plant—once blamed for the deaths of millions—was genetically modified to produce nutrients found in human breast milk, marking its transformation from killer to healer (Entine). But it isn't so surprising that more and more such astonishing news is inundating the field of Bioengineering. Since hominids stepped out of the darkness of the caves, we have experienced several spikes in our intellectual evolution that have propelled us forwards as a species. The Scientific Revolution of the 16th century. The Enlightenment of the 18th century. And now, we are currently riding the waves of the latest of our times - *the Digital Revolution*. The Internet of Things (IoT) and Artificial Intelligence has made it possible to make leaps and bounds in the field of medicine, blurring the margins of the realm of possibility. This tremendous shift in biotechnology demands a clear ethical stance, not hesitation. With its potential to address human sustainability, resistance against genetic diseases like cancer, and development of human capabilities, genetic engineering should be considered an ethical choice that becomes a necessity for the continuous evolution of our species.

Genetic Modification : A Philosophical Quandary

From a philosophical perspective, bioengineering has definite merits and purpose. Our lives are given meaning because we live according to a higher order; societies are created around a set of moral axioms, by which we are bound and which serve as the bedrock for the betterment of the world. In "The Metaphysics of Morals" by Kant, it is stated that it is the moral duty of humans to better themselves. He argues that it is an imperfect obligation owed to oneself involving the cultivation of virtues such as beneficence, honesty, etc. Thus, self-enhancement is a moral imperative according to Kantian philosophy, but also that which is supported by John Stuart Mill's theory of utilitarianism (Johnson and Cureton). In *On Liberty*, Mill states, "the worth of a State...is the worth of the individuals composing it," arguing that there are ripple effects of self-improvement and that it ultimately leads to the good of society at large ("Schumatcher center").

The potential of bioengineering allows humankind to tap into and utilize all our natural faculties, so that we may transcend our physical limitations and reach a higher plane of existence. Through the augmentation of our genetic blueprint, we may become stronger, more resilient. When the individual himself is physically and spiritually robust, his family prospers, his nation prospers, and eventually the Earth as well. These views are shared outside of Anglo-American and Continental philosophy. Although the Confucian vision on gene enhancement relies on context, it supports the idea that if the result is the betterment of the family, such practices are acceptable (Joseph et al.). The continuous betterment of the world and all that is in it roots bioengineering in an ethical endeavor that is espoused by both western and eastern philosophies (Chenyang).

Therefore, since the main aim of genetic modification is to improve the health of the world and all its inhabitants, it should not be seen as a question for regulatory legislation or some other external order, but rather as a moral obligation considered through an interdisciplinary lens.

Solution to Survival of the Species

In any case, the emerging proof that genetic modification is key to the sustainability of the human population (and by extension, global ecological systems) is undeniable. Genetically modified organisms (GMOs), for example, can serve a wide range of benefits. According to the worldometer, the population has grown from 1.6 billion to 6.2 billion during 1900 to 2000, a staggering 386% increase within a decade (“Worldometer”). The only morbid counteracting force against the runaway train that is our growing population is the death of more than 25,000 people per day who fall victim to starvation (Nations). GMOs offer the solution to food shortages - they allow for greater yield, rapid cycling of crops, and resilience against environmental stresses. While some “organic-only” purists may harp on the Frankenstein anatomy of these GMOs, falsely accusing it of being full of “chemicals”, the fact of the matter is that they are actually more nutrient-dense than non-GMOs. For instance, genetically modified rice with high iron, zinc, and vitamin A was intentionally grown in Southeast Asia to combat deficiency of these nutrients in the local diet (Mayer).

For countries that face challenges of declining birth rates like South Korea, which has one of the lowest around the world with its fertility rate of 0.75, genetic technology arrives as a lifesaver - or, more aptly put, giver (Lee and Yi). IVF, in vitro fertilization, is a reproduction method that fertilizes sex cells outside of the body. MRT, Mitochondrial Replacement Therapy, replaces damaged mitochondria in the gamete to healthy ones so that offspring can prevent genetic disease (Claiborne et al.). MRT solely does not contribute to the birth rate, but it gives impact to IVF users to avoid implanting embryos with abnormalities such as down syndrome or autism. This genetic innovation serves as a solution for infertility. This eventually allows people who are unable to naturally reproduce to have healthy children. People who overuse steroids can be infertile, but this technique may repair such damage (News Medical).

Tinkering with a single nucleic acid can cause a ripple effect on the global scale, with profound implications for the environment. Global warming may soon be a problem of the past. In 2019, scientists successfully modified a bacteria called *Pseudomonas putida* so that it could degrade atmospheric pollutants like nicotine or benzoate (Zhou et al.). Humans single-handedly create the most waste on the earth and with genetic modification, we may be able to erase our carbon footprint.

Amongst the myriad of pros of bioengineering, possibly the most important one is its potential to eradicate disease. CRISPR/CAS9 is a genetic technology that has been praised for its application to agriculture. Using CRISPR, scientists deleted the mutant gene in pigs suffering from PRRS, porcine reproductive and respiratory syndrome, single handedly curbing economic losses in the swine industry (Whitworth et al.). CRISPR may also be key to finally discovering the elusive cure for cancer. This genetic technology allows targeting specific oncogene or tumor suppressor genes like KRAS or TP53, where the

mutation forms most frequently (Kanbar et al.). By editing those genes, restriction of cancer growth will be possible.

Our relationship with the natural world is dynamic, and humanity must do everything in its power to maintain the precarious balance between life and death. Our intellectual toil eventuated in something that may be our chance at redemption, for the hundreds of millennia of plundering Mother Nature. Why should we not permit ourselves penance? Using genetic modification to make the human race more resilient and intelligent as a species will create more stable societies: economies will flourish, crime rates will dwindle, etc. The utopia of sci-fi and fantasy novels might be within our reach after all. Elon Musk's vision of Mars colonization, in which we become a multi-planetary species with a self-sustaining extraterrestrial society, no longer sounds like a far-fetched dream (Murray). With genetic enhancement, human civilization can breach a new era where only the edge of the galaxy is the limit.

“Playing God” and “Designer Babies”

The loudest argument against genome modification is that humans have no authority to “play god.” This theological assertion presupposes that there is some distinction between human and divine exploits (Locke). It makes the claim that bioengineering disturbs the natural mechanisms that should be left to take its course organically. The secular notion of the “sacred” makes *therapy* a mitigation of humanity's fall from the kingdom of grace and *enhancement* an affront to God who created man in His image.

But despite the popular view that bioengineering is on the chopping block because it is considered blasphemous to tamper with God's divine designs, many religions are actually in support of it. Christianity, Buddhism, Islam, and Judaism all show acceptance for this new technology. Buddhists, for example, agree with the Human Genome Project because they see it as a way to alleviate human suffering which aligns with their tenets of belief (Cornel). Perhaps the most surprising, but paradoxical, is the Jewish perspective. Though the Jewish have historically suffered the most because of Eugenics, they are also the most receptive to genetic technologies such as in-vitro fertilization (Cornel). At the very least, the dialectical view of theology embracing science removes any doubts about genetic engineering from the religious perspective.

Furthermore, concerns regarding genetic modification are raised with topics of personal freedom, giftedness, and uniqueness. At the forefront of the wave of criticism is Jürgen Habermas who warns of a violation of human dignity and autonomy. Specifically, he is concerned with the reification of the lifeworld, where human life and value is turned into a fixable, tangible object that becomes commodified (Jürgen 101). For example, when parents are choosing traits for their babies such as intelligence or height, this can limit a child's own freedom of what he or she wants to be (Thompson). This engineering can potentially alter their identity and jobs with their superior traits along with high expectations from parents for them to follow a predetermined path.

Many of these consequentialist arguments hold no water because they are merely contingent. They are built upon false deterministic assumptions, first of all. Actually, genetic technology provides people with not less, but more control over their own biology, which translates to more opportunities for the individual. For instance, if someone is born with a genetic disorder, gene editing would enable them to live a normal life to their full potential. Experts say that being "authentic" is not inherently genetic but also determined by an individual's personality, experience, and their environment ("Babatuyi 1").

At the core of the problem is the principle of "human dignity." A universal phrase yet one that no one can agree upon on its meaning. A broken bone or a stolen wallet is a concrete, measurable infringement. Violations against human dignity? Less so. Because the concept is so nebulous - just that, a concept - it is difficult to use it as a means of arguing for or against genetic modification. Andrew M. Joseph et. al (Joseph et al.) ran a comprehensive study on the diverse perspectives regarding this issue and arrived at two conclusions: one, "human dignity" must be defined singularly; and two, it cannot be used to definitively stall the matter of bioengineering at this moment.

In the Eye of the Beholder

Science is in and of itself inherently morally neutral. Only in the hands of the wielder does it become a weapon or a tool. Although this article embraces genetic modification, it would be an insult to discount the opinions of those against it. Saying that their worries are just the primitive animal response to be wary of the unfamiliar and novel, is reductive. Those cynics and naysayers are precisely the reason why humanity is able to walk a moral path (most of the time) because they constantly make us ponder, *is this the right thing to do?* In school, children are taught of the dangers of technology through novels like "Brave New World" by Aldous Huxley. In media, portrayals of dystopian societies overrun with robots such as with "Blade Runner" keep us in check because we are afraid of what may happen if we let ourselves run amok with Science. But because we are afraid, regulations are put in place to prevent abuse, organizations oversee each other's activities, and operations are always held under scrutiny. Of course, genetic modification could be dangerous. But so is drinking too much water. If we can harness the technology in the right way, it has the potential to improve the world in so many ways and due to that possibility, it is something that we are morally ought to do.

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