Genetic Modification: An Expansion of Biotechnology and Bioethics Encoded in Human Dignity

Brianna Feld

Through the process of scientific inquiry and empirical experimentation, scientists have asked simple questions that have led to powerful new tools and technologies transforming basic research, translational biology, and medicine. The question of what makes the crystal jellyfish glow when agitated led to the discovery of green fluorescent protein, now widely used in cell and molecular biology as a reporter of gene expression. Discoveries in bacteria with modified mechanisms of DNA repair synthesis allowed scientists to develop Polymerase Chain Reactions (PCR), currently the standard assay to detect coronavirus. One of the most powerful biotechnological tools discovered was through the study of a defense mechanism in E. coli, currently known as Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR), making possible the ability to insert or delete any known DNA sequence, thus "mastering" our own genome.

Genetic modification involves the use of modern cutting-edge biotechnology to alter the genetic makeup of any organism. There are two types of genetic modification: somatic and germline. Somatic cell modifications occur only in the individual whereas germline modifications occur in the germ cells altering not only the individual but also future generations. While genetic modification usually denotes a restoration or improvement of function, genetic enhancement or human enhancement technologies is "the directed use of biotechnological power to alter, by direct intervention, not disease processes but the 'normal' workings of the human body and psyche, to augment and improve their native capacities and performances."

The topic of human genetic modification elicits pertinent questions to consider when engaging in an ethical discourse. Thus, the title of this paper is best explained in the questions it poses. Are these technologies considered safe? Who will have access? Do the benefits outweigh the risks? Do individuals have the right to alter their own genome and the genomes of their children? These first four questions address a normative, Western paradigm of bioethics addressing the four principles of non-maleficence, justice, beneficence, and autonomy, respectively. However, when considering human genetic modification on a global scale, there must be an expansion to include global bioethical considerations of such as issue.

This broadening perspective includes questions such as: Who will be the most vulnerable to such technologies? What kind of new disparities will these technologies bring? Since our genome codes who we are as humans, will altering this code strip us of what makes us human? These questions cannot be answered under a purely principlist bioethical paradigm, there must be a widening to recognize a universal framework based on human rights and respect, encoded in human dignity.

I will analyze arguments for and against genetic modification highlighting expanded principles of vulnerability, solidarity, and human dignity. A central argument in support of genetic enhancement is improvement and beneficence. The obligational aspect of beneficence in this case is to improve humans' quality of life if the means to do so are accessible, thus presenting a consequentialist line of reasoning. Hence, genetic enhancement is good because there is an obligation to do good if we possess such knowledge. Examining improvement and beneficence in a global sense, the "malaria gene drive" illustrates a potential benefit to such genetic editing technologies. In 2014, genetic scientists engineered CRISPR-based gene-drives systems to eradicate malaria-carrying mosquitoes. Since malaria

disproportionately affects the African continent and as of 2019, infects 229 million people worldwide, this genetic editing could prevent a major disease globally. Do the benefits outweigh the risks of altering entire populations of organisms allowing for the possibility for the malaria parasite to further mutate or even be used nefariously for biological warfare?

A second argument for HETs is for therapeutic treatment purposes. There exists a "phantom line" between therapeutic treatment and enhancement. The blurring of this line is evidenced in the 201 case in Hong Kong which shocked the world as the first known germline editing on human embryos. Dr. He Jiankui used this CRISPR technology to target the CCR5 gene to provide a mutated receptor inhibiting HIV from infecting immune cells, thus conferring genetic resistance to HIV. This first appears to be a case for therapeutic treatment. However, it is well known that in cases of paternal HIV, there is a negligible risk of transmissibility when the sperm is washed and resulting HIV-negative sperm fractions are used. Given this present alternative method to prevent the transmission of HIV to future children, a case of therapeutic treatment cannot be made. This is a clear example of human enhancement.

An argument presented against HETs is the indirect and direct harms to future generations. Indirect harm is evidenced by issues of inequity and injustice, namely the less equal societies maintaining a greater overall burden of health and social problems. This highlights the necessity for a widening of bioethical principles to include solidarity when analyzing the argument of inequity and injustice in genetic modification.

Direct harm is the direct result of enhancement. The CRISPR twin babies will live with both positive and negative effects of this novel technology. Their genomes and their progenies' genomes will be forever altered. Although CRISPR editing is superior to other

genetic editing technologies, it maintains the potential for unmitigated off-target edits conveying potential direct harms to future generations Genetic interventions providing "enhancement" of certain desirable traits now could be evolutionary "undesirable" in the future, leaving future generations vulnerable to new pathogens, natural disasters, and ecological change. This "mastery over nature" could lead to a global ecological disequilibrium. Such as in the example of the Malaria Gene-Drive, if adequate research and knowledge in CRISPR gene-drives is not obtained, catastrophic effects could occur to an ecosystem thus affecting all participants in said ecosystem. The same is true with human genetic enhancements as selecting for certain traits ourselves could either give us an even great advantage over other organism, driving this disparity and inequality in species or alternatively, leave us vulnerable to unforeseen evolutionary changes and events. Thus, the principle of vulnerability must be considered when expanding the paradigm of global bioethics.

The final principle I believe to be most foundational to include when considering human genetic enhancement is the importance of inherent human dignity. Human dignity is the first principle supported by UNESCO's *Universal Declaration on Bioethics and Human Rights*:

i. Human dignity, human rights and fundamental freedoms are to be fully respected.

ii. The interests and welfare of the individual should have priority over the sole interest of science or society.

To possess dignity is to hold honor and respect, to attain value or worth. When coupled with the word "human," dignity then provides a context as to what or who is given this worth,

and as a result, what protections are afforded to the agent possessing this value. Inherent human dignity is the respect and worth inherently given to all humans equally in a specification solely based on their human condition.

Utilizing Kantian philosophy, the means is the concept of a non-instrumentalization of the human being, meaning that humans are never means and only ends in themselves. This indicates a rational, intrinsic human worth insusceptible to appraisal as its value is inherent in its very identity. There can therefore be no price or qualitative worth placed on intrinsic value such as human dignity. There is a givenness to our human nature, to the world's human nature. Dignity is given, as are virtues and vices to accept and improve upon. Dignity however cannot be something improved or raised in value – it is value in and of itself. It is important to question whether this human dignity is maintained in human enhancement technologies.

My critical stance on genetic modification is twofold. First, this technology is too valuable and beneficial to not use in certain cases. In cases of somatic therapeutic use, I believe genetic modification should not only be allowed but encouraged. The principle of beneficence applies when the treatment is proportional to the disease. It was possible to eradicate the polio virus with vaccine biotechnology; is it not only necessary, but also ethical, to eradicate a global disease such as malaria with gene editing technology that we currently possess? However, the benefits must outweigh the risks. It is unethical and entirely irresponsible to gene-edit mosquitos without first understanding the effects on the ecosystem. The potential benefit to human beings is not a substantial reason to contribute to an ecological disequilibrium.

Secondly, CRISPR is an already widely used tool in the scientific community. Like many technologies before it, it possesses incredible benefits and detrimental risks. I believe using CRISPR for basic biology research, somatic gene editing, and eradicating global diseases such as

malaria are all beneficial and ethical uses of this technology. However, I do not believe CRISPR and other gene-editing technology should be used for germline modifications and enhancements. Doing so would violate global principles of human dignity, vulnerability of future generations, and human solidarity to those persons who would inevitably not receive equal access.

What then, are the ends of biotechnology? Biotechnology should be used as a tool, as a means to an end and not an end in itself. What is the goodness of the ultimate goal? Thus, the principle of therapeutic proportionality applies in this sense and can be expanded to include the distinction between genetic therapeutic advancement and genetic enhancement. If the ultimate good is health, then the instrumental ends of genetic medicine can be justified and beneficial. However, in cases of human enhancement, there is no conceived end. Surely happiness cannot be at the end of such means. It is a path of destruction damaging the biosphere, our fellow organisms and ourselves. Our ability to construct tools and manipulate our surroundings is our lasting evolutionary trait. But with this ability, comes the responsibility to use such technology prudently.

The creators of such powerful biotechnologies maintain an ethical responsibility of care, respect for vulnerable persons, and an overarching reverence for human dignity and human rights. As biotechnology continues to grow and expand, so will the need for bioethics to expand to include solidarity, vulnerability, and human dignity. This continued expansion of both biotechnology and bioethics must remain encoded in inherent human dignity.