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Genetic Enhancement of the Inevitable

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I: Introduction

Over the course of human history, civilization and technology became more intertwined as our understanding of the natural world grew with advancements in knowledge. This understanding, in turn, granted humanity the ability to rectify earlier misconceptions about the universe. For example, the geocentric model was of common conception before Nicolaus Copernicus and Galileo Galilei challenged that notion. Their research based on telescopic observations of Venus led to the creation of the heliocentric model. Despite the evidence supporting the heliocentric model, there was a widespread denial of its use until much later. Evident in the past and now, human imagination far surpasses the scientific process, sometimes hindering developments in science. While imagination is essential for inspiring discoveries, it can cause people to fail in comprehending the real issues within these breakthroughs; seen by the heliocentric model and now with genetic enhancement. Where many discuss the supposed ramifications of its practice specifically involving the production of "designer babies" with CRISPR gene editing technology.

Nonetheless, I will argue that concerns regarding "designer babies" fail to fully understand and address the facts because of their misunderstandings about the technology behind genetic enhancement. Prior fears of gene editing date back to philosophical literature based on human imagination rather than scientific rationale. These fears are now commonplace and resulted in the current moratorium since there are many unknowns about genetic enhancement. I envision that genetic enhancements will become commonplace given further safely guided research. Despite our current moratorium, further research into genetic enhancements will be accelerated once a country showcases its technological advances with gene editing. This global competition will, unfortunately, resemble the current nuclear arms race in which multiple countries aim to build nuclear weapons to maintain their superiority. Similarly, countries will progress research into gene editing to retain their dominance. As a preventative measure, I strongly propose that governments should take measures to safely research gene editing with the aid of independent regulatory bodies formed from philosophers, politicians, ethicists, and scientists.

Currently, our existing knowledge of gene editing technology has led to two main points of utilization: therapy and enhancement. Broadly, gene therapy is the treatment of impairment, injury, disease, or disorder by changing or replacing damaged genes with healthy genes. On the other hand, enhancement is a change that improves someone or something. For most people, genetic enhancement falls under this broad umbrella of enhancement as a concept, leading to several misunderstandings about the technology. A common definition of genetic enhancement is the modification of DNA for cosmetic purposes. This explanation begets the stigma of being an augmentation of intelligence, athleticism, or charisma through gene engineering; resulting in the present apprehensions surrounding designer babies (Almedia 2019). The folly in this understanding lies in the misunderstanding that these traits are each attached to one singular gene. A gene is capable of expressing multiple phenotypic traits; this phenomenon is known as pleiotropy. A change in a gene can cause numerous effects throughout the body because of how the genetic networks are interconnected (Almedia 2019). Attributes like muscle strength, intelligence, and memory manifest depend on a variety of genes that play upon each other. As a result, these misunderstandings in earlier philosophical debates, namely a single gene controlling a key trait, led to a flawed understanding of the technology and culminated in current fears and wild speculation about the future usage and scope of practice for genetic editing.

To rectify this apprehension, we must first address the public's understanding of both gene therapy and enhancement. As a case study, both could be applied to cognition, a process where an organism categorizes and utilizes information. An intervention via therapy or enhancement would focus on perception, attention, understanding, retention, and reasoning. Gene therapy, for example, uses direct modification to restore injured genes with beneficial genes. In the sphere of cognition, therapy is an intervention directed at restoring either the pathology or defect of a cognitive subsystem. Within the realm of cognitive enhancement, enhancing "somebody whose natural memory is poor could leave that person with a memory that is still worse than that of another person who has retained a fairly good memory despite suffering from an identifiable pathology, such as early-stage Alzheimer's disease" (Bostrom 2009). An enhanced individual is a person whose capabilities in a respective area such as cognition are improved without correction to any dysfunctions in that area.

Research into prior literature points to an apt definition for genetic enhancement: the changing of a set of genes toward the desired end goal. For our purposes, let's take a closer look at one such goal: increased intelligence. In our modern society, intelligence is held near-ubiquitously as a desirable trait, but what exactly is intelligence? Is it faster recall times, increased short-term memory, better neural networks, or even photographic memories? There are far too many ways to define intelligence and even more to become intelligent. The variability of characterizing intelligence lends itself to the problem that "the characteristics that people want to enhance maybe those that are most amorphous or difficult to pin down" (Rosoff 2012). Similar to genetic therapy, genetic enhancement focuses on improving a lifestyle while not focusing on a particular disease or illness.

The distinction between these two aspects of genetic editing is "often difficult to discern, and it could be argued that it lacks practical significance" (Bostrom 2009). Best seen through the following example, "Children who are very short due to a deficiency in growth hormone are classified as receiving treatment in getting synthetic growth hormone. Meanwhile, children who have normal levels of growth hormone, but are equally short simply because their parents are short, count as medically normal, so their receiving synthetic growth hormone counts as enhancement" (DeGrazia 2012). Previously, philosophers have entered this debate within this area of distinction regarding the morality of the practices.

Common philosophical and ethical arguments against genetic engineering feature themes like required enhancements or a loss of personality. These include: “parents opted to select for athletic prowess, musical talent, superior intellect” (Cohan 2005); “a child’s free will is limited by a predisposition to a set of behavior traits and temperament”; or “genetic enhancement would create an unequal world, where the enhanced are far superior to those who aren’t.”
On the surface, these contentions appear to highlight the flaws of genetic enhancement. However, they feature a frequent problem: vagueness in the scientific application alongside a lack of scientific rationale. The technology was infantile at best during the period when these arguments were made, primarily since science has only scratched the surface potential of gene editing. In this article, I argue that these conversations fail to grapple with factual issues because of their misunderstandings about the technology behind genetic enhancement. Consequently, these misinterpretations have led us to debate the wrong issues rather than focus on creating regulatory schemes that include broad conversations between the public, moral philosophers, and scientists. In both sections II and III, I will review the common arguments against genetic enhancement in the philosophical literature and demonstrate these concerns are unjustified.

Lastly, in section IV, I will argue that while the current call for a moratorium on gene editing related to genetic enhancement is sensible, the debate for the future must involve scientists alongside ethicists and the public, all of whom need to work in tandem to develop a workable scheme for reasonable regulation.

Section II: Discrimination and Inequalities

Some fear the high pricing of diverse types of genetic enhancements due to current trends in the pharmaceutical industry. For example, life-saving and essential prescriptions were gated behind skyrocketing prices. The foremost example of this was the actions conducted by Martin Shkreli to artificially inflate the price of Daraprim. This cost increase was caused by his ownership of the patent on Daraprim, effectively allowing him to decide the base price. This has contributed to the fear of inequality widening due to genetic enhancement because of patents and the potentially high price tag.

However, the world faces inequalities in many facets of life; for example, there are differences in education, nutrition, and healthcare among individuals. These inequalities lead to a trend of those who have access to a better lifestyle versus those who do not. The difference in education is illustrated between public and private education. It is no secret that our public school system is lacking in some areas in comparison to private schooling. A disparity compounded by the expenses a parent or teacher may shoulder when factoring in extracurricular activities or standardized testing, such as the SAT or ACT. The same follows for nutrition, where cheap but highly unhealthy meals are unfortunately a more convenient alternative for some families. These inequalities are gated by uneven finances, worsening the current predicament. These bleak prospects fuel anxieties that genetic enhancement would only increase these disparities, where only the rich and highly privileged would gain access to genetic enhancements due to the prohibitive costs of enhancements. Alternatively, others worry that genetic enhancements could be gated due to exclusive patents controlled by individuals or corporations. These restrictions could cause an increasing divide between higher and lower socioeconomic individuals and families.

People also fear that there will be discrimination against those who lack superior enhancements or no enhancements. This claim flies ignorantly to how society presently treats individuals with disabilities. There is no "diminishment of society's acceptance of, for instance, amputees since the decline of wars, infections, and industrial accidents created ever fewer of them" (Hughes 2018). Moreover, the Genetic Information Nondiscrimination Act (GINA) protects individuals from any genetic discrimination (2008). Furthermore, due to the various methods to increase a trait like cognition through various related aspects, a singular patent on an enhancement is unlikely to widen the current inequalities. With multiple ways to enhance a given trait, there will be multiple ways of access for families. Moreover, some ways of access to improving cognition normally are seen through education, medication, mental training, or caffeine. Some of these methods of increasing cognition are also seen as enhancements and are widely adopted and employed as societal norms.

Alternatively, another argument states that the world will become separated between those that can afford the treatment to become "superhuman" and those that cannot. However, under the new framework established, there are multiple methods to enhance a characteristic since the body is made up of various systems working together. Cognition, for example, is a trait that can specialize in perception, attention, understanding, retaining, and reasoning as an organism uses these processes to categorize information (Bostrom 2009). To demonstrate this principle, scientists employ mice in laboratory research due to their genetic and biological similarities to humans. As a result, mice have many utilities concerning human genomics through the lens of environmental and pharmaceutical effects on health. An enhancement could focus on one of these areas and adjust genes that produce more NR2B, which causes mice to "[show] improved memory performance, in terms of both acquisition and retention" (Bostrom 2009). The NR2B subunit is related to synaptic plasticity; as individuals age, there is a decrease in NR2B subunits, and this is believed to be related to age-related memory loss. An increase in NR2B in this scenario enhances learning and memory by increasing synaptic plasticity. Overall producing more NR2B subunits enhances cognitive ability or intelligence. On the other hand, mice who had a deleted cbl-b gene demonstrated regular learning capabilities but increased long-term memory retention. The gene is seen as a negative regulator of memory; removal of the cbl-b gene in mice indicates that there were changes to neural plasticity. These enhancements would focus more on the retention aspect of cognition. However, this same effect can arise due to education and training to develop skills like concentration, memory, and critical thinking. Alternatively, substances like caffeine offer similar effects through increased awareness and alertness. These distinctive styles of enhancement all feature a similar prospect: a barrier to entry is the cost. Yet unlike genetic enhancement, other forms of enhancement are actively encouraged by society. Moreover, as demonstrated above due to the multitudinous nature of genes, there are different approaches to enhancing a specific trait. As a result, multifaceted treatments are difficult to patent and control. While there may be more efficient and effective therapies, inequalities would not drastically increase with the addition of genetic enhancement (Bostrom 2009).

Lastly, the disparity between individuals already exists in other fields, such as education, nutrition, and healthcare. For example, pharmaceuticals are far cheaper in other countries than in the US. As a result, the US government is working toward price restrictions on essential and life-saving medications. Furthermore, health agencies have "programs in place to study and ameliorate health inequalities" (Hughes 2018). It is unlikely that research into genetic modification will result in "radical improvements in health, cognition, or longevity" (Hughes 2018). Equitably addressing genetic modification would ease common concerns about genetic enhancement. Addressing these concerns will require a strong regulatory process to ensure equality for all, worrisome with the present mishaps of public and private health insurance. Yet, the government has expanded access to therapies by "require[ing] that insurers cover infertility testing and fertility therapies" through statehood legalities (Hughes 2018).

Section III: Uniformity

Another premise states that parents will select traits to be enhanced, developing the child to specialize in a particular area. Consequently, there will be a lack of identity for the designer baby. Moreover, they theorize that select attributes will accumulate in the human species, resulting in uniformity of traits. The notion references arguments like genetically modified crops being weak against a single deadly virus strain. This idea ignores the crucial role that nurture plays in the development of humans. Identity is a mix of nurture and nature because culture, a part of nurture, affects self-identity. Identical (monozygotic) twins share the same genetic information but develop uniquely in separate environments. These identical twins can differ in areas like the development of diseases such as schizophrenia, lupus, or erythematosus (Rosoff 2012). A person’s personality, behavior, and characteristics are not solely derived from genetics but also from environmental effects. Moreover, political, social, historical, and religious backgrounds create a complex system that interplays with an individual's genes.

Prior philosophical arguments do not evaluate the impact of the environment on an individual. For example, if a parent wanted their child to be a better pitcher, no gene increases pitching ability. Instead, some sets of genes could theoretically increase oxygen intake, decrease muscle fatigue, or increase hand size. Parents can select which genes they wish to alter; similarly, they can choose an elementary school or nutrition plan for their child. Genetic enhancement is nothing more than an extension of these tactics. Moreover, it is up to the individuals themselves to use these improvements and develop a skill set to take advantage of them. The ability to throw a curve, four-seam, sinker, or splitter ball is not derived from gene editing but from practice that comes from an individual's dedication. Michael Phelps was born with a greater arm span, a longer torso, larger arms, and a better lactic acid system. For the sake of an example, we could pretend that Michael Phelps is one of these genetically enhanced children. Opponents against enhancement will claim that there is no way for a regular child to contest against Michael Phelps; however, his 18-year 200-meter butterfly world record was beaten by 19-year-old Hungarian Kristóf Milák, proving that genetics alone is not the decider for everything. This directly opposes the notion that those who are genetically enhanced are far superior to those that are not. Even if one were given the best set of talents, one needs to nurture an aptitude to use those talents. Nature and nurture work together to make up an individual's strengths and weaknesses.

Moreover, there is a scenario where "the talent gap decreases because it turns out to be generally easier to enhance individuals at the low end of the performance spectrum than those at the high end whose brains are already functioning close to their biological optimum" (Bostrom

2009). While slightly grounded in the fact that drug studies support this postulate, currently there are no existing forms of enhancement to prove or disprove such theories (Randall et al. 2005).

Section IV: Moratorium

An emerging consensus on gene editing is the desire for a global moratorium on heritable human genome edits. The moratorium is a self-imposed measure to prevent the clinical use of any tools that aid in editing human germline cells. This measure could quickly develop into a border moratorium that would prohibit research into general germline modifications for any application (Gilbert 2015). Currently, the consensus is to pause research on editing "human eggs, sperm or embryos until gene-editing technology" is better understood (Weintraub 2019). This measure is a temporary stopgap in name as it allows for somatic cell research to continue. A scientific moratorium on this topic would be akin to the suspension and delay of research on germline cell edits. This delay exists due to the worry that genetic enhancement could lead to "designer babies". Currently, this moratorium focuses more on the scientific approach to gene editing while not exploring the philosophical and ethical angle. This point is demonstrated when Dr. Lander, the president of the Broad Institute of both MIT and Harvard, called for scientists to deliberate whether people should have access to germline gene edits rather than including other disciplines (Weintraub 2019). A similar concern was brought up before the Asilomar Conference about recombinant DNA technologies in 1975, an issue that could result in "frameworks for regulatory decision-making [to] continue to largely preference science-based knowledge and technical risk assessments" (Getz 2019). Any open discussion of germline genome editing typically lacks insights from "policy-makers, ethicists, philosophers, and the public while focusing heavily on scientific voices" (Getz 2019). An issue the Asilomar Conference rectified as it was a group of biologists, lawyers, and physicians who drew guidelines for recombinant DNA technology. This conference was important since it aimed to put scientific research into more of the public domain and included various professionals. It proposed guidelines for new scientific progress and how to regulate any misuse. This moratorium is a temporary measure before a certain point where scientists globally will use germline edits. Thus, it is imperative to include public participation to prevent narrative doubts like designer babies. During the duration of the moratorium, scientists will better understand the scope of somatic cell edits on human beings. For example, scientists could focus on treating "diseases including sickle cell anemia, Huntington’s disease and Duchenne muscular dystrophy" (Weintraub 2019). Furthermore, knowledge of these beneficial applications would present a case for somatic cell genetic enhancement. Since both the public and the larger scientific community would understand their fears of the technology are unfounded.

As stated, while the existing moratorium on genetic modification is a proper measure, it falls into similar actions taken by philosophers. Philosophers did not use aspects of science in their arguments, leading to the current concerns about genetic modification. Moreover, the moratorium discounts the importance of novel technologies like xenotransplantation, where pig heart valves are used for patients with diabetes and pigskin serves as grafts for severe burns patients. The process “involves the transplantation, implantation or infusion into a human recipient of either (a) live cells, tissues, or organs from a nonhuman animal source, or (b) human body fluids, cells, tissues or organs that have had ex vivo contact with live nonhuman animal cells, tissues or organs” (Pandey 2022). Through the combination of both gene editing and xenotransplantation, humans can house genetically enhanced pig organs. Pigs, in particular, are suitable donors for hearts due to their similarities in structure and function. Currently, the moratorium is not equipped to oversee recent technologies like xenotransplantation.

While the moratorium on germline genetic modification is an appropriate step in curbing unwanted and unethical practices, these therapies need to be studied in both animal and human clinical trials. The first published utilization of editing genes of the embryo in the United States occurred due to private funding. Private funding is capable of skirting the blockade presented by the moratorium whereas the moratorium would hamper public funds usage on research. A lack of public access to research information would privatize genetic modification and shape the public practice of enhancements (Hughes 2018). Unfortunately, a moratorium might also be difficult to enforce due to the "low cost of CRISPR and heterogeneity of regional ethical codes" (Evitt 2015). Regulation in this scenario should focus on the utilitarian approach. Utilitarianism is an ethical theory that states that actions that maximize the happiness (balancing positive consequences over negative consequences) of all affected parties are morally good, where the affected parties are the parents and children from the action of enhancement. These actions would maximize happiness as improvement leads to better well-being and lifestyle. Moreover, fostering further discussion on this topic would result in greater access by the public to these resources. These regulatory processes would benefit from the current moratorium established by scientists to involve outside parties like legal experts, ethicists, and philosophers. Primarily since this action will quell any misguided doubts while also developing the moratorium's stance on an equitable future.

The National Institutes of Health (NIH) and the Food and Drug Administration (FDA) cooperatively agreed to a plan to remove redundancies and overzealous oversight on gene therapy. Moving forward, human gene therapy research and trials continue under the FDA who has regulatory oversight. Whereas any NIH funded research is prone to NIH oversight and local oversight from the Institutional Review Boards (IRB) and Institutional Biosafety Committees (IBC). Originally a Recombinant DNA Advisory Committee (RAC) was established to aid the FDA since they cannot regulate cosmetics that classify genetic enhancement. Additionally the RAC was set to review the same proposals as the NIH, a redundant measure now removed (NIH, 2019). The NIH instead repurposed the RAC into Novel and Exceptional Technology and Research Advisory Committee (NExTRAC). This committee aims to provide advice emerging topics in biotechnology in regard to ethical and safety issues. Moreover, the committee aims to organize focused discussions in the field to contribute to new literature. The NIH and FDA require additional funding to create a universal framework for conducting enhancement research to lower the barrier of entry. This would resolve any new problematic issues in the development and lower barriers to discussion (Breakefield 2012). A lower barrier of entry prevents a central group from controlling access to technology. The steps taken by the NIH and the FDA are demonstrative of proper action to appropriately handling gene technologies rather than the current moratorium. Additionally, this board should conduct a full Institutional Review Board (IRB) review on any research proposals for genetic enhancement that focuses on toxic proteins, off-target edits, mosaicism, lifestyle edits, and somatic/germline modifications. IRB reviews are essential in preventing any unethical experimentation as well as any "adverse social impacts of biomedical enhancements" (Mehlman 2011). Furthermore, the government can establish more robust laws and protections if more research into genetic enhancement occurs. These would include infrastructure like laws, civil rights, and protection that will help those who do not wish to be genetically enhanced, as well as help inform parents to provide consent to any therapies and present equal access and patient choice.

Section V: Conclusion

Most of the discussion thus far has been on hypotheticals of what genetic enhancement could be. Genetic enhancement at its core is a form of technology, one subject to change and growth; as seen by genetically augmented xenotransplantation. When computers were invented, few believed they would become something that would have access to entire worldwide knowledge and be of pocket size. Similarly, genetic enhancement currently is in its infantile stages and what is known is extraordinarily little. The lack of information breeds misconceptions about the definition of genetic enhancement. As a result, the portrayal of genetic enhancement is the idea that a single gene modification will alter fate. In reality, “the effects of a single gene are much harder to show” (Steinbock, Arras, 2013). Our body has numerous measures to ensure the proper translation of information. These measures come in the form of built-in redundancies to prevent any mishaps from genetic mistranslation. Genetic enhancement requires the effect of multiple genes to make an actual difference. Genes only play a portion in the development of an individual; the environment mentioned earlier is a factor in the utility of such enhancements.

Athletes have aggressive workout regimes to maintain their state of play. While their genetics does give them an advantage, it is up to them to sustain that advantage or squander it. Additionally, humans develop not solely by their nature but also through their nurture, resulting in varied individuals. Genetic enhancement is nothing more than another societal enhancement that only serves to better everyone. An issue brought to light by the current moratorium is yet doomed to fail since it does not receive input from critical parties like legislators, philosophers, and ethicists. I would suggest that the moratorium should focus on featuring more of an openness to legislation, ethics, and philosophy. Especially since computer science as a whole has been moving towards more of an open-source philosophy that fosters more creativity and community support. Computers were first developed to compute higher-order calculations; they were not banned because they had the potential to harm. Despite various hacker organizations utilizing computers to commit fraud or theft, computers were not banned. Rather, the field was properly regulated, and laws were passed to prevent and penalize those involved in these crimes. Computers then represented a shift for civilization as a whole; similarly, genetic modification will cause an upheaval in culture, economics, and society. We currently hack computers and modify them to do incredible things, we will soon hack our bodies to fantastical notions.

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