The Ethics of Genetic Engineering: Is it Eugenics?

This country has had significant history in the area of Eugenics. The 1920's and 30's were a time where Eugenics was apart of the popular culture. Everything from church sermons to Saturday night cinemas and even state fair family contests advocated the eugenic ideology of immigration restriction, race segregation and sterilization of those considered to be inferior and infiltrating the "fit" population. This popular movement was started by Galton in England, a cousin of Charles Darwin, when he coined the term "well-born"[1]. Scientists formed the group the American Breeders Association where they did research trying to validate the hereditary differences found amongst different people[1]. At the forefront of this movement were very influential men such as Mr. Kellogg who created the Race Betterment Foundation[1]. Nonetheless this movement reached high tide until the 1960s where multiple states upheld a eugenics policy sterilizing up to 60,000 people[2]. While this form of eugenics is forever engrained in the history of America some argue that eugenics continue to pervade the US today. This form has cleverly hidden itself in the form of scientific study and innovation. This new form of eugenics is genetic engineering.

According to Michael Boylan and Kevin E. Brown they termed genetic engineering to be "the introduction of a fully functional and expressible gene into a target cell, resulting in permanent correction of a specific genetic disease: when the target is a tissue or an organ within an organism, this is somatic gene therapy; targeting the eggs or sperm to affect all the cells in the offspring of an organism is germ-line therapy"[3]. This definition elegantly describes genetic engineering with subtle hints to its eugenic consequences. This paper explores different types of genetic engineering and a handful of its moral repercussions ultimately culminating in the author's view and internal dilemma surrounding this topic.

Genetic engineering can be divided into four main categories: somatic therapy, somatic advancement, germ-line therapy and germ-line advancement. This chart clearly separates the different types of genetic intervention allowing for ethical analysis to be conducted on the separate parts.

Figure 1		
	Therapy	Advancement
Somatic	1	2
Germ-line	3	4

Somatic therapy has gained the most support for genetic modifications due to its therapeutic interventions. Imagine 20 year old Clarisse who has been living with type 1 diabetes. This disease has left her always double checking what she eats, her routines after a workout and always on the brink of fear of her insulin pump giving out. After so long with these worries she wishes that there is a treatment that could forever change her life for the better. It is in situations like these that gene therapy on the somatic cell line shines with flying colors. Not only does somatic therapy has the opportunity to "fix" genetic mutations, it does so without ever affecting the germ-line thus containing the effects (whether positive or negative) to the individual. In the category of somatic therapy, an ideal candidate is single gene causing diseases for if altered, it does not cause effects on other parts of the body because it is not linked to other genes. This technique gives us the possibility of being several steps of the severe diseases that so commonly take the lives of many humans. The ability to cures one's disease has been supported by many research studies and some has had translational effects in the clinic (i.e. X-linked adrenoleukodystrophy[3]). Its effects have been so beneficial that the UK has made it legal to use genetic engineering to correct defective genes. With its ever increasing popularity, the boundaries between somatic therapy and advancement have become more and more unclear. Take for example the case with HIV/AIDS. Certain people have different genetic susceptibility

to the HIV virus invading the T-cells on their immune system. It can be argued that large scale genetic therapy should be done to eliminate the protein receptor that permeates the harmful effects on those with the higher chances of contracting the disease. But how do we define those who are at higher risks? Should it be for the surgeons who are working in areas of high prevalence of the disease or should it be to people who have a higher chance on contracting due to their close interactions with those who do? Our current medical technologies allow us to give vaccinations to prevent certain disorders and it is generally agreed upon that HIV infection is in fact horrible to have. With this in mind, one can argue that genetic intervention to prevent HIV should be considered a therapy as opposed to an enhancement. On the contrary, it can also be considered an enhancement because different people do have naturally acquired genetic resistance thus genetic interventions that do prevent HIV infection can be considered an enhancement[4]. The line between advancement and therapy continue to become undefined. A way of combating this issue is to clearly define what is considered to be healthy and what is disease. The definitions of these are subject to multiple interpretations thus creating to the uncertainties in delineating advancement from therapeutics. The ethical dilemmas that arise from genetic engineering rarely target this type of genetic engineering. Rather it targets the genetic modifications done on the germ-line cells.

Genetic modifications on the germ-line are on the rise. More and more people look towards in vitro fertilization techniques and recombinant DNA to genetically manipulate and improve human embryos. The ability of the parent to pick and choose the genetic makeup of their children has been coined Liberal Eugenics. During pre-implantation genetic diagnosis, parents have the ability to select embryos with the requested traits as well as embryos free of genetically passed down diseases. While one can be considered to be therapy of the germ-line (avoiding

genetic diseases) the other can be considered to be germ-line advancement (picking desirable traits). The issue lies in whether the genetic alterations made are effective or efficient. An effective genetic modification has the ability instill change in tissues and organs that may be affected. An efficient change as the ability to not only change the affected tissues and organs, but also the germs cells thus creating genetic change in further offspring. This shows that there is much more risk involved in germ-line genetic treatment. Where in somatic therapy, if the procedure goes wrong, it is only confined to individual in germ-line therapy, if the procedure goes wrong, it is forever preserved in the further generations. Science has left us with the uncanny ability to essential play the role of God and determine the genetic makeup of our future generations. It was put quite clearly by Kevin Fitzgerald, The Dr. David Lauler Chair in Catholic Health Care Ethics in the Center for Clinical Bioethics at Georgetown University Medical Center, "A variation of the germ-line intervention safety criticisms is the objection that humankind is not capable of employing such a powerful technique without resulting in horrible abuses, if not tragic disasters"[4]. Even with this fear of creating a tragic disaster, some in vitro fertilization (IVF) practitioners are advocating the desirability of gene manipulation to the point where IVF will become the best mode for childbirth because they can ensure that no "defective" embryos would ever be re-implanted back into the women. Perhaps which have already implanted through natural conception could be flushed out of a woman's uterus and be genetically characterized[5]. IVF in combination with genetic engineering has allowed this new form of eugenics to flourish in our current society.

The genetic advancement of germ-line cells leads us to the question of how do we determine viable traits to possess? Immediately without much thought most people would say that they want aesthetically pleasing, smart, and athletic children. While this may be the most popular

answer, others may think differently. A case study taken for the book *Liberal Eugenics: In Defense of Human Enhancement* presented the case of a two deaf lesbian partners who wanted to have a deaf child. Since no genetic engineering technique had been in place to fulfill their needs, they went to multiple sperm banks in search for a donor who matched their criteria. They were denied by all of the sperm donor facilities for their request was unusual. In an effort to get what they wanted they approached a deaf male friend who has had deafness in his family for four generations. Consenting to be their donor, this lesbian couple was able to have a son who was deaf but only in one ear. If genetic engineering practices where in place, this couple could have received exactly the child they wanted. Keep in mind that the same technologies that could potentially be used to make a smarter child could also be used to make a deaf child. Proponents of this story gave the argument that this couple did just what any other couple would do with genetic engineering; pick the traits they want their baby to have. They further went on to justify their arguments by saying that if one of these lesbian women actually fell in love with this deaf man (attracted to him by his deafness) then this would have been an ordinary situation of two people falling in love and manifesting their love via a deaf child. Furthermore, author went on to say that those heterosexual couples are subconsciously attracted to one other because they feel that the other person has traits suitable to pass down to their offspring thus justifying the lesbian couple's decision. Lastly they went on to say that at least the boy is alive and partially deaf as opposed to not being alive at all. The difference between the lesbian couple and a couple made up of a man and woman is that the lesbian couple outspokenly expressed their ideas of what they want. If they had the ability to copulate with one another, this story would loose its uniqueness.

Stories like these beg the question of how do we control the use of genetic engineering practices? Drawing parallels from other branches of medicine, in particularly the cardiovascular industry,

doctors have admitted to use of certain products on children when they were originally intended for adults. This off label use of medicine or medical technique is all to common in the medical world. It is often said that it is better to use something than nothing at all. The paper by Christine Ewing cited a doctor from the University of Edinburgh who was part of the team that made the DNA probe to identify the male-Y-chromosome in embryos of four to eight days. He commented that the probe was developed for prenatal diagnosis of sex –linked genetic disorders…[but they] couldn't prevent the technique from being used in that way," in other words sex determination of babies[5]. The repercussions are large for certain cultures deem having a male child as more valuable than having a female. This technique essentially eliminates the probability of having a girl or a boy and gives the mothers an opportunity to get rid of the child based on gender alone. Although the intentions of these products was meant to serve the greater good, scientist, doctors and researchers have to re-evaluate the products the are developing and using. We are only as good as our latest invention. With the amount of interest in this field, more and more ideas manifested into reality are on the brink of discovery and it only takes one person to misuse the product before others start joining in. How can we as consumers of this product balance the intended benefits of genetic engineering technology with the potential harms?

With every new technology, there is a margin of uncertainty. In the current discussion on genetic engineering, it is pertinent to say that these uncertainties range from formation of new disease by the treatment of another, the risk of severe immune reactions from vectors in gene replacement, and also the risk of super viruses arising from facilitated recombination between viruses and cells. Tampering with the intricacies of nature to fix one genetic problem could lead to the formation another unforeseen issue. This uncertainty is readily apparent in the tampering of germ-line for it can be transferred to generations to come. The combination of natural evolution with that of

manmade evolution can ultimately lead to unforeseen consequences for it creates more genetic variation. More variation could potentially lead to speedy realization of genetic disorders not presently exhibited. Furthermore, the use of viruses to insert the gene of interest poses a huge risk. Viruses are superb in infiltrating the host organism and inserting their genetic makeup. Harvesting this technology for the in vivo and ex vivo form of gene therapy may be problematic. Two main reasons for this is because the ex vivo technique uses retro viral vectors that can easily cause cancer and the in vivo technique uses adenoviruses which do not integrate themselves into the chromosome and are les likely to disrupt the genome[6]. In both cases, the viruses can amount an undesirable immune response. Lastly, the recombination between viruses and cells can lead even better super viruses that dominant over any modern medicine on the line of defense. This would leave us weaponless for viruses mutate on several orders of magnitudes faster than humans. The incorporation of viruses with our cells could make it harder for us to attack the viruses without attacking our cells as well. Despite the advancements in area of genetic engineering there are still areas that need improvement.

A quick look at the current arena for genetic engineering shows a variance in the types of technologies that are available. According to Genetic Engineering and Biotechnology News, their headlines highlight advancement stories such as the first human embryonic stem cell trial to combat muscular dystrophy commences in Europe, the first patient to be treated with gene therapy technique for an incurable form of blindness and other not so successful cases such as a company that has to lay off works because the benefits of their therapy for combating lipoprotein lipase deficiency did not outweigh the risks thus negating them of the highly desired and needed approval to market, pervades the gene therapy briefs page. With such headlines flashing positive feedback in trials, one has to step back and realize that getting to the stage in which these

therapies are used in the clinic is quite difficult. Researchers have to ask multiple questions such as *what it is the target cell, how will it be accessed, what proportion of cells need to be corrected, will over expression of the protein become disease, over what period of time does the new protein have to be or be functional, is there a choice of* vector before they can make to the stage in which they test patients[3]. It is an extremely long and time intensive research endeavors that rarely produces successes.

After synthesizing numerous books and articles I have come to the conclusion that genetic engineering is ethically viable to a certain extent. As a researcher in an interdisciplinary lab in the orthopedics department of the medical school, I am involved with gene therapy research in which I believe has the potential to create a positive change in the field of genetic engineering. The lab was founded on the basis of using non-viral methods to treat diseases. In particular we focus on bone, vascular and cartilage. The majority if not all of our research would be therapeutics for the somatic cell line. This hints at my position of whether genetic engineering is a form of eugenics. When it is used in treating the somatic and germ-line defective genes I believe that it is not considered eugenics. However, if used for the enhancement of somatic and germ-line cells then I considered it to be and form of eugenics. Although it seems so clear, we have to remember that the line between advancement and therapeutic is extremely blurred making hard to distinguish one from the other. For those situations in which a patient is truly suffering due to their genetic make up, then genetic engineering should be used to combat the disease. Using the technique for the selecting of characteristic traits should not be advocated. Rather it should be left to natural selection with the combination of God to determine the traits of the future.

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