Ethics in Genetic Engineering
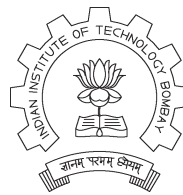
Seminar Report

HS623:Problems in Social Ethics

by

Jagadish M(07305050)
Annervaz(07305063)

Department of Computer Science and Engineering
Indian Institute of Technology, Bombay
Mumbai

Contents

Abstract

Genetic Engineering(GE) presents an exciting range of possibilities, from increased crop production to preventing and treating diseases to eliminating harmful genes; it holds too much promise of benefit to ignore. However, this promise is not without potential hazards. Genetic engineering presents intriguing and difficult challenges for 21st century scientists and ethicists. In this report, we look at some of the major ethical implications of this fast-growing field.

1 Introduction

It is surprising to note that much of the technology that we take for granted today, was conceived only a few years ago. Just as the last two decades saw an unprecented growth of computing, the twenty-first century promises to do be a DNA age. Computing has brought about major changes in how we work, communicate, and play. Genetic engineering enables scientists to create plants, animals and micro-organisms by manipulating genes in a way that does not occur naturally. The suddenness with which the area has developed has posed many challenges to scientists and governments alike. We are on the verge of being able to transform and create organisms for any number of productive purposes. There are a number of companies that have hoping to take early benefit of this area. Companies like `Genetech` and `23andme` are venturing into the field of personalised medicine based on one's genome. If fact, today with $399 and a sample of your saliva, you could start exploring your genome. Here is an extract from `23andme`'s website:

> Even though your body contains trillions of copies of your genome, you've likely never read any of it. Our goal is to connect you to the 23 paired volumes of your own genetic blueprint (plus your mitochondrial DNA), bringing you personal insight into ancestry, genealogy, and inherited traits. By connecting you to others, we can also help put your genome into the larger context of human commonality and diversity.
>
> Toward this goal, we are building on recent advances in DNA analysis technologies to enable broad, secure, and private access to trustworthy and accurate individual genetic information. Combined with educational and scientific resources with which to interpret and understand it, your genome will soon become personal in a whole new way.

As knowledge of the human genome increases, pressure will inevitably build to move forward with genetic engineering. We have begun reaping the practical rewards of genetic engineering such as new medical therapies and increased crop yields and so far only a few instances of measurable harm have resulted.

Provided that it is appropriately regulated, bearing in mind ethical concerns relating to dignity, harmful consequences, and justice, its potential benefits outweigh its harms. As indicated, some significant moral implications ought to be taken into account as we go forward with genetic engineering. This report we look at major ethical concerns about genetic engineering. Before moving on to discuss the ethical implications, we briefly review the science underlying genetic engineering.

2 Background of Genetic Engineering

Engineering is the technological manipulation of the objects of the natural world in a way that is perceived to be beneficial to people. Traditionally we used the word in the context of inanimate objects like building, cars, railways etc. But the term can be used and is used in the context of biology, namely for bioengineering, i.e. modifying or manipulating living organisms. DNA is the blueprint for the individuality of an organism. The organism relies upon the information stored in its DNA for the management of every biochemical process. The life, growth and unique features of the organism depend on its DNA. The segments of DNA which have been associated with specific features or functions of an organism are called genes. For example, a particular gene may determine your eye color or height or risk of a getting a diabetes, etc. *Genetic engineering is a laboratory technique used by scientists to change the DNA of living organisms.*

2.1 Variants of Genetic Engineering

Gene Therapy: Gene therapy is a technique for correcting or preventing defective genes responsible for disease development. Researchers may use several approaches for correcting faulty genes, most commonly, a normal gene is inserted into a nonspecific location within the genome to replace a nonfunctional gene[5]. The Food and Drug Administration (FDA) has not yet approved any human gene therapy product for sale.

Gene Enhancement: Genetic enhancement refers to the transfer of genetic material intended to modify nonpathological human traits. The term commonly is used to describe efforts to make someone not just well, but better than well, by optimizing attributes or capabilities– perhaps by raising an individual from standard to peak levels of performance. When the goal is enhancement, the gene may supplement the functioning of normal genes or may be superseded with genes that have been engineered to produce a desired enhancement. The procedure followed in similar to that of therapy.

Somatic and Germline: The gene therapy and enhancement discussed above can be of *somatic* or *germline*. Somatic refers to body cells and germline refers to reproductive cells. Changes made to somatic cells are restricted to the individual, while changes made to germline cells are passed on to future generations. Germline genetic enhancement is, not unexpectedly, the most controversial form of genetic intervention.

Cloning: Organism cloning refers to the procedure of creating a new multicellular organism, genetically identical to another. In essence this form of cloning is an asexual method of reproduction, where fertilization or inter-gamete contact does not take place. Dolly, the sheep, was the world's first cloned adult animal. The scientists who cloned Dolly are to stop experiments involving genetically modifying pigs for human organ transplants because of concerns that deadly new diseases could be passed on to people.

3 Ethical Dissection

In this section, we look at the various objections, arguments for and against different aspects related to genetic engineering.

3.1 Theological Perspective

> We are sometimes invited to play God, and we are sometimes warned against it, but before we decide whether to accept the invitation or to heed the warning, it would be good to know what it means to play God.
>
> –Allen Verhey, *"Playing God and Invoking a Perspective"*

The theological argument against GE follows from the grounds that life is sacred and should not be altered by humans. By 'playing God' we are interfering with the natural process of creation and thus are violating the will of a God. This argument is does not have solid grounding since most theologians themselves agree that God expresses himself in every facet of creation. Genetic engineering can be viewed an expression of free will[1]. The other argument against GE is that it changes the fundamental nature of an organism in a way that would never occur in nature and hence it is immoral to do so. This argument too does not have a strong basis since the very definition of technology is to alter nature for the betterment of living. Our culture exists solely because of human inventiveness and our ability to change the natural order thrust upon us. Also, we are unclear on the very definition of what is 'natural' and even if genetic engineering is unnatural there is not reason why it should be unethical.

3.2 Secular Perspective

The secular argument against GE has been that life in its natural state, i.e., unaltered by human intention is inviolable because of its inherent dignity. This argument does not hold good in face of natural 'indignities' that occur in nature. For example, a person suffering from Lesch-Nyhan syndrome(a genetic disorder[4]) has an uncontrollable desire to self-mutilate himself, so for that person, dignity is not in his natural state but rather in overcoming it. Overcoming our natural disadvantage is does not violate our inherent dignity. John Stuart Mill based his theory of liberty on human autonomy and self-determination[3]. It is our autonomy to dispose ourselves as we please that gives us dignity as human beings, therefore in this sense modifying our genes to get rid of our disabilities is not inherently wrong.

Intrinsic and Extrinsic Ethical Arguments

Intrinsic ethical arguments are arguments about whether GE has some intrinsic value or not. Extrinsic ethical arguments are arguments about the ethical status of GEs applications or consequences.

3.3 Reductionist view

Genetic engineering requires that we take a reductionist view of life that sees only genes, not individuals, as important. Quoting an expert on the subject Jeremy Rifkin: "From the reductionist perspective, life is merely the aggregate representation of the chemicals that give rise to it and therefore they see no ethical problem whatsoever in transferring even a hundred genes from one species into the heredity blueprint of another species."

But the reductionist is not only pertaining to Genetic Engineering, the allopathic treatment system itself is based on such an view. So criticising genetic engineering on this plane is not very fair, the relaxation allowed to the allopathic medical treatment have to be leveraged to GE too.

3.4 Quantitative/Qualitative

Somatic genetic engineering is in principle similar to other established treatment methodologies like blood donation or organ transplant. It is not qualitatively different from these, although quantitative gap from them is enormous. The effects of Somatic GE are fast and on a much higher scale[2].

3.5 Utilitarian Perspective

Genetic Engineering on crops can be advocated from a Utilitarian perspective. Any logical assignments of value to the results and effects of Genetic Engineering on crops, will favour it. Even GE on animals is favourable from utilitarian perspective, but the uncertain behavioural effects of GE on animals are/may be much higher, and cannot be incorporated in a utilitarian analysis with due weightage. So a utilitarian analysis may not be appropriate in the case of animals.

3.6 Rights Perspective

Genetic Engineering on crops is favoured from a typical rights perspective. As per experts GE is the only solution for the world hunger.

> "Unless we are ready to accept starvation, or place parks and the Amazon Basin under the plough, there really is only one good alternative: discover ways to increase food production from existing resources."
>
> Martina McGloughlin in "Ten Reasons Why Biotechnology Will Be Important in the Developing World,"

To duly respect the right of all to live with the basic life requirement, we need genetic engineering. Again therapeutical GE on humans can be advocated from rights perspective, on grounds that a patient has a right to healthy living. Other forms of GE on animals, cannot be analysed completely from a rights perspective because of the uncertain nature of the effects.

3.7 Justice Perspective

As all forms of genetical engineering will be accessible to more, may be only, to the rich class of society, this will lead to polarization of society. So from a justice perspective, genetical engineering is not favoured. But this criticism even exists for other medical treatments, so the qualitative similar GE method, that is Somatic GE, has to be looked with a relaxed version of the criticism. Germline GE and Cloning can never be seen with favouring eye, as the results are far-reaching and uncertain, and the polarization it causes in the society is much severe and uncontrollable. The possibility of creation of human slaves by rich has to be seen with utmost caution, and has to be prevented.

3.8 Ethical Arguments against Germline GE

The changes made by Germline GE are permanent and irreversible. This forces us to make a decision, that will result in the selection of one and rejection of other gene. As there is no ultimate notion of good, this selection rejection process is difficult. For example, sickle-cell anaemia allele is more resistant to malaria, so permanent rejection of a particular gene is difficult, and if done the loss might be tremendous.

Another severe argument against Germline GE, is it kills the variety on Earth. As any selection with precision becomes possible, humans will tend to select as per the current trend/fashion. This will lead to the permanent wiping out of the some traits like black skin color from the human community. It might end up with the case that, humans will be similar to a batch of cars produced from a factory. It kills much celebrated *human spirit*.

The most severe and controversial argument against Germlne GE is because of its unpredictable and unintended results. The case of *Terminator* corn, was a less dosage warning for humans in this regard. A genetical modified corn variant pollinated natural corn and the off-springs where impotent. Severity of such unseen possibilities, advocates not to practice Germline GE, atleast till more scientific elucidations are available.

3.9 Better Safe than Sorry

At this point in time, many decisions about using genetically engineered crops and animals are decisions under uncertainty, ie Consequences of our actions cannot be assigned probability numbers. Typically for decisions under risk, we can very well assign probability numbers to the consequences of action. In case of GE we have not reached even that context, so it might be better to wait, than to be sorry later.

> When an activity raises threats of harm to the environment or human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

> –Wingspread Statement on the Precautionary Principle

4   Beyond for and against

This is a highly decisive area, which can alter or even terminate our future. The nature of the area demands sophisticated ethical guidelines, so we have to promote more rigorous analysis on the topic. The risk GE brings, in terms of the stratification and polarizations of the society is very high and has to be prevented at any cost.

References

[1] David Koepsell. The ethics of genetic engineering. *Center for Inquiry Office of Public Policy*, 2007.

[2] Hon-Ming Lam. Social and ethical implication of biotechnology. Note available at `ihome.cuhk.edu.hk/ z045513/coursematerial/elsi.pdf`.

[3] Stuart Mill. On liberty. *Republished by Forgotten Books*, 1853.

[4] Richard Preston. An error in the code. *New Yorker*, 2007.

[5] Micheal J. Reiss and Roger Straughan. *Improving nature?: the science and ethics of genetic engineering*. Cambridge University Press, 1996.