

GENETIC ENGINEERING

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Brock defends the prospective use of genetic engineering to enhance human traits and functions against various moral objections. He rejects the idea that genetic engineering (of an embryo) would change the fundamental identity of an individual in a way that the efforts of parents to develop the capacities of their children by manipulating environmental factors do not. He also rejects the idea that the treatment of disease is objectively beneficial for an individual in a way that enhancement of normal function would not be. Brock acknowledges that some enhancements of normal human traits and functions would be beneficial only within a limited range. He also briefly considers whether there is any justified basis to the moral concern that the use of genetic engineering to enhance particular human capacities would transform and devalue the associated human activities. Next, he argues that any moral assessment of genetic engineering for purposes of enhancement must take account of *who* is employing the relevant genetic technology (e.g., whether it is government or parents), and he concludes his analysis by acknowledging that the use of genetic engineering to enhance capacities that would confer competitive advantages on recipients raises serious issues about fairness and equality of opportunity.

In June 2000 government and industry groups jointly announced that the goal of the worldwide Human Genome Project (HGP) to map and sequence the entire human genome had essentially been completed. Of course, enormous work still lay ahead to understand the specific genes that contribute to human disease and disability, much less to the multitude of complex physical, cognitive, emotional, and behavioral traits of normal humans. No one can confidently predict the rate at which that understanding will be achieved in the future nor the ultimate limits on it. The way in which genes interact with other genes and with different environments only multiplies what we still for the most part do not yet understand. But, despite how much remains to be learned, we have already made great strides in beginning to understand the genetic bases of human nature. Much of the initial work in the HGP has focused on a search for the specific genetic contributions to human disease and disability. The gene has been identified, and tests for it developed, that allow prediction with a very high

degree of certainty of whether an individual will develop Huntington's chorea, an adult-onset, single gene disease that leads to devastating neurological deterioration and death over a period of years. In other cases, genes have been identified, and tests for them developed, that only increase individuals' risks of developing diseases like breast cancer.

At present, this new information still allows only limited and relatively crude control over the genetic inheritance of our progeny. A couple who know from family history or other means that one or both are at risk of passing on a particular genetic disease to their children can test for their risk of doing so before conception. If a risk is found to be present, various means, such as sperm or egg donation, *in vitro* fertilization (IVF), pre-implantation embryo testing, or forgoing conception, are now available to avoid transmission of the genetic disease to future children. After conception, testing of the fetus is sometimes possible to determine whether it carries the gene or genes for the disease, and the parents can then decide whether to abort an affected fetus. While such testing is now possible for only a quite limited number of diseases or disabilities for which there is a significant genetic component, we can expect

these capacities to continue to expand rapidly in the future. Moreover, the capacity to detect deleterious genes is likely to be combined with new abilities for *in utero* therapeutic interventions or genetic manipulations to correct for the deleterious gene(s). Thus, we can expect that advances in genetic knowledge and technology will increase our ability to prevent or to reduce the prevalence of disease caused in significant part by deleterious genes.

It is not just much disease, however, but virtually all normal human traits that have some significant genetic basis. The same advances in genetic knowledge and technology that will enable us to prevent disease will ultimately enable us to undertake interventions to manipulate the genes underlying normal traits and functions and to enhance those traits and functions in the absence of any disease or disability; it may become possible to manipulate genes to enhance normal intelligence or memory, immune responses to many human diseases, physical strength or dexterity, and life expectancy, to take only a few examples. Thus, we face the prospect of being able to take control over and to design human nature and the nature of our progeny. What was once in the hands of God or the natural lottery will come increasingly within deliberate human choice and control. This [essay] is about some of the ethical issues we can expect to face when we gain that control.

In the limited space available here, I will not pursue the technical means by which these genetic interventions will likely occur. While some bases for them are already in place, how they will develop is speculative and uncertain at this time and while some of the ethical concerns will be specific to particular technical means as they develop over time, most of the deepest ethical concerns do not turn on the specific technical details of genetic interventions. I will understand "genetic engineering" here to mean the deliberate alteration or addition of genes in a human embryo; this includes somatic cell genetic interventions that affect only the subject of the intervention as well as germ cell interventions where the changes will be passed on to the progeny of the subject of the intervention. This means that our current means noted above of preventing the passing on of genetic disease are not instances of genetic engineering as I will understand it here. . . .

USE OF GENETIC ENGINEERING TO ENHANCE NORMAL FUNCTION

To use genetic engineering . . . to seek to prevent genetic diseases and the suffering and disabilities that they cause does not seem morally wrong and may sometimes be morally required. This is in keeping with efforts in medicine more generally to prevent or treat disease and the suffering and disability it causes. However, many people worry that the use of genetic engineering to enhance normal function in persons who are without disease raises fundamentally different and deeper moral concerns than the medical use of genetic engineering. Yet what could be wrong with parents using the technology of genetic engineering if it becomes available to improve their children's lives and opportunities? Parents are generally regarded as having permission, and in some cases an obligation, to produce the best children they can. They are expected, for example, to keep their children as healthy as possible. If genetic techniques gave parents a way to enhance their children's immune systems, and the intervention posed only risks comparable to vaccination, should parents not be free, or even required in some cases, to use them? Parents invest time, efforts, and resources in developing athletic talents, intellectual abilities, and prudential or moral virtues in their children. If parents have great leeway in attempting to produce the best children they can, according to their own view of what is best, why not extend this liberty to genetic means?

ENVIRONMENTAL VERSUS GENETIC CHANGES

Some opponents of genetic engineering mistakenly see it as changing the fundamental identity of a person in a way that parents' environmental efforts do not. They see parental efforts as environmental in helping to develop the capacities their children already have, as bringing out the potential that is already there. In contrast, genetic interventions are seen as changing children in some more fundamental way, making them different from who they otherwise would have been. But this contrast is problematic. When parents use their control over environmental factors to "bring out the best" in their children, they

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modify phenotype. Given their children's genotypes, the range of traits and capabilities—both physical and behavioral—that constitute the phenotype of the child we see and interact with is very much a result of the environment that parents and others create. There is no pre-existing and fixed best in the child that is brought out by parental manipulation of environmental causes; such manipulation has enormous effects in shaping and determining phenotype. Why not then add to parents' arsenal of methods whatever genetic interventions make it easier to accomplish their goals for their children?

Part of what disturbs many people is the mistaken belief that genetic interventions modify the essence or identity of the individual, whereas environmental interventions only modify accidental features and leave identity unchanged. The idea seems to be that genetic interventions result in a new individual, whereas environmental interventions merely modify the same individual. But our genes do not constitute our identity in any deep sense. Suppose the operation of our immune system could be enhanced or our eye color changed by a genetic intervention. We would not be inclined to muse: "I wonder who I would have been if my parents had not altered my immune system or eye color in this way?" We might have very different responses if they altered genes that produced major changes in aspects of the self that we consider central to our sense of self or personal identity. For each of us, it is particular elements of our phenotype, such as being intelligent, compassionate, or witty, not every aspect of our genotype, that we take to be central to our conceptions of self and to our essence as a particular individual. These traits are produced by interactions between our genotype and our environment and neither means of altering them is more fundamental.

WHEN ARE ENHANCEMENTS
BENEFITS?

Treatment of disease that restores normal human function is typically and uncontroversially assumed to benefit persons. One source of moral concern and unease about genetic engineering is whether enhancing individuals' normal human traits would in fact be beneficial for them. In *Brave New World*, Aldous

Huxley (1946) imagined engineering some persons to have limited abilities and aspirations, and to be happy doing menial jobs in society. While this might be beneficial for the society, it was morally objectionable in exploiting those individuals for the benefit of the rest of society. Morally acceptable genetic engineering of individuals should, certainly in the great majority of cases, plausibly be of benefit to those individuals from their own perspective.

Are treatments of disease objectively good for a person in respects in which enhancements are not? For example, treatment that prevents paraplegia seems uncontroversially and objectively beneficial to anyone, whereas enhancement of a capacity to excel in athletics or play a musical instrument may only be beneficial for a person with interests in these activities. However, this is not a contrast between genetic engineering used for treatment versus enhancement, but rather a contrast between abilities that are all-purpose means, useful in virtually any plan of life, and abilities useful in some plans of life but not in many others. Some enhancements of capacities like memory or the ability to focus attention on tasks for extended periods of time would likewise be useful in nearly any plan of life, whereas treatment, for example, of a disease that impairs fine motor skills might be very important to a pianist but of little importance to a person who did not make significant use of those skills. There is no systematic contrast between treatment of disease and enhancement of normal function that makes the former objectively beneficial in a way the latter is not.

THE MAGNITUDE OF ENHANCEMENT

If disease is understood roughly as a condition causing an adverse deviation in normal species function, however, treatment that prevents or treats disease and so maintains or restores normal function will be at least *prima facie* beneficial for a person. Moreover, the attaining of normal function provides a rough stopping point for successful treatment. On the other hand, in the use of genetic engineering for enhancement, the limits of possible changes in people's genetic inheritance are more open-ended both in the capacities that might be enhanced and in the degree to which the capacities might be improved;

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there is no obvious end-point to potential enhancements comparable to the role normal function plays with treatment. How much stronger or smarter or more memory should we aim at?

It might seem that the more a desirable trait is enhanced by genetic engineering the better, but that would be a mistake for at least two reasons. First, some enhancements would only be beneficial within a limited range because of how the enhanced capacity or trait would interact with the individual's other capacities or traits. For example, enhancing some forms of memory beyond a limited range might so interfere with other forms of memory or other cognitive processes as to be, overall, undesirable instead of a benefit. The second reason why some enhancements would only be beneficial within a limited range is that beyond that range individuals would become unsuited for human social life. For example, there are well-known social benefits to being tall. That is why growth hormone—a pharmacological intervention—that raised a normal individual's height to several inches above the norm might be a beneficial enhancement. But there are limits to how much of an increase in height would be beneficial. To grow to be 9 ft tall, certainly not now possible with growth hormone, would be on balance harmful in nearly any human society because our social world is constructed for persons whose height rarely reaches beyond 7 ft at most. One would literally become, in a physical respect, unfit for human company. And if the change were still more dramatic, as in the case of Gulliver in Lilliput, it could become hard to see the individual still as a member of the same species. Many changes in human features and capacities by genetic engineering would only be beneficial within some range, and public policy could quite appropriately regulate its use to ensure that it stays within the beneficial range.

THE MEANS USED FOR ENHANCEMENT

Is it morally important that genetic engineering is the means used to enhance human capacities? Of course, means may vary in various morally important ways, such as the risks they carry, but is there something about genetic manipulation itself that raises moral worries? Many people admire others who have de-

veloped skills and abilities through long hard effort that they would not admire when the means used was genetic engineering. Moreover, sometimes a valued activity is defined in part by the means it employs, not just by the end at which it aims. It was a great achievement several years ago when IBM's computer "Big Blue" beat the then world chess champion Gary Kasparov. But it surely was a very different achievement from the one in which a human challenger recently beat Kasparov. And suppose an IBM engineer who designed Big Blue's program and implemented the moves it chose claimed that he was the new world chess champion. Here, means make all the difference in the chess skills and successes with which the engineer should be credited. In many valued human activities, the means of acquiring the capacities are as much valued and admired as the performance itself. Opponents of genetic engineering on these grounds will need to show that enhancing particular human capacities by genetic engineering as opposed to other means transforms and devalues important activities that employ those capacities.

WHO IS USING GENETIC ENGINEERING?

It will often be morally important who is using genetic engineering technologies to enhance a particular capacity. I believe the most important differences are between three cases: first, when government employs or strongly encourages their use; second, when individuals use them on others, most importantly parents on their children; third, when individuals use them to enhance their own capacities (strictly, this last would not be genetic engineering as defined above, but genetic interventions may become possible later than the embryo stage of development). The most obvious difference is between the first two cases and the third, since the first two raise the issue of the justification of some persons acting to affect someone else; for example, it is widely held that individuals are justified in taking risks for themselves that they would not be justified in imposing on others. Less obvious, but at least as important, are the different degrees and forms of neutrality about what is a good life that are properly expected from the state, from parents toward their children, and from individuals in their own lives.

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In liberal democracies, it is widely held that the state should seek to be neutral between different comprehensive conceptions of a good life that its citizens may hold. This liberal neutrality places substantial limits on governmental action to employ, encourage, or require the use of genetic engineering that would only be beneficial in some specific conceptions of a good life. The genetic engineering compatible with this liberal state neutrality is roughly that which enhances what John Rawls (1971) called primary goods, that is, general purpose means useful in a wide variety of, if not virtually all, plans of life. Placing fluoride in the water supply is justified on these grounds: enhancing resistance to tooth decay is beneficial no matter what one's particular plan of life. Enhancing memory by genetic engineering might be as well.

Consider now parents' use of genetic engineering for their children. Whoever has primary responsibility for raising children—in most societies, parents—must have substantial discretion in the values they impart and the particular capacities they seek to develop and enhance in their children. There are moral limits, however, on parents' authority to enhance their children's capacities, whether by genetic engineering or other means, as the following case illustrates. Suppose parents put their 7-year-old daughter into an intensive tennis training program to develop her potential to become a professional tennis player; whether wise or not, parents are generally accepted to have the right to do this. But suppose the parents also proposed to withdraw her from school because they believed her education was interfering with her tennis training. Public policy, quite properly, would not permit them to do so because, although it might enhance her tennis skills, it would be at the cost of severely limiting or neglecting many other capacities and opportunities she would otherwise have later to choose and pursue other, different, life plans. Parents do not have an unlimited moral right to shape their children and their children's capacities at the cost of denying them a reasonable array of opportunities to select and pursue their own conception of a good life as they mature and develop the capacities to make those choices. Children have what Joel Feinberg (1980) has called a right to an "open future," which is derivative from the more

fundamental right of adults to self-determination in making significant choices about their lives for themselves and according to their own values or conception of a good life. Disagreements will arise, of course, about the extent or scope of a child's right to an open future and what would violate that right, but the right places significant limits on the use of genetic engineering by parents for their children.

If individuals could use genetic engineering for themselves, neither of these forms of neutrality would be required because their doing so would be an exercise, not an infringement, of self-determination or autonomy. Public policy might legitimately seek to ensure that such choices are well informed, particularly when there are significant and irreversible risks, but it should not substitute its own judgments about when genetic engineering would be desirable for the voluntary, informed judgments of competent adults. As a general matter, we have seen that who would be using genetic engineering could be important for the moral justification of that use.

IMPACT OF GENETIC ENGINEERING ON FAIRNESS AND INEQUALITY

I want finally to provide what I believe is the most important example of the moral issues public policy will face in responding to widespread new capacities for genetic engineering that enhances normal capacities. The problem arises when an enhancement by genetic engineering would confer a substantial competitive or positional advantage on its recipient, thereby strengthening an individual's position relative to others in competitions for scarce roles or benefits. If the genetic engineering is expensive and distributed on the basis of an ability to pay for it, then only the economically well off will get it. This will raise concerns about fairness and equality of opportunity, specifically whether those who cannot afford genetic engineering have a fair opportunity to compete for the benefit against those whose capacities to compete have been enhanced by genetic engineering. Imagine that the children of the higher socioeconomic classes not only have the social advantages they now typically have, but that they also have certification that their intelligence, memory, immune system, and capacity to concentrate attention on tasks for extended periods of time have all

been enhanced by genetic engineering. This would be a very significant advantage in work and other contexts; it would likely significantly increase inequality and would raise serious issues of fairness and equality of opportunity for public policy. Public policy could reasonably regulate the use of genetic engineering that would unfairly increase inequality, but there would be an important moral complication in doing so, quite apart from generating the necessary political will to do so.

Many real enhancements that may become possible through genetic engineering will in part confer positional or competitive advantages, but will in part confer non-competitive or intrinsic benefits as well. Take the example of enhancing individuals' capacities to focus their attention more intensely for significant periods of time on a particular task or activity. Many adults with no disease or deficit now use the drug Ritalin for this purpose. This would confer a significant advantage in work contexts. But it would also increase individuals' intrinsic satisfactions from activities like listening to music, watching films or sunsets, and so forth, none of which are competitive benefits that make anyone else worse off. The quandary for public policy is that concerns about fairness and equality of opportunity would support limits on this use of genetic engineering, but these limits would at the same time deny individuals the opportunity of gaining significant, non-competitive benefits in their lives.

Public policy will face other difficult issues in responding to new capacities for genetic engineering, including regulation of competitive enhancements that would be self-defeating if widely used and regulation of the risks that will be inherent in their use. Whether used for treatment of disease or for enhancement, genetic engineering in humans should

take place only after careful evaluation to ensure that its risks are justified by its potential benefits—this will be especially important for any germ-line interventions. But the potential long-term adverse impact on inequality and fairness may well prove to be the greatest challenge.

The moral and policy issues that will likely be raised in the future by new capacities to employ genetic engineering to prevent disease and disability and to enhance normal human capacities will ultimately concern how we are to shape our nature as humans. Some people will condemn any such interventions as "playing God," but I believe the potential for human benefit makes any general moral bar to their use unjustified. What I have tried to do in this [essay] is to articulate some of the moral and policy issues that we must confront if we are to use genetic engineering wisely, safely, and ethically.

ACKNOWLEDGMENTS

This [essay] draws heavily on Brock (1998) and Buchanan et al. (2000).

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ANNOTATED BIBLIOGRAPHY

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