Enhancement Technology, Ethics, and Public Policy

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Introduction

Gene technology has spawned a wide range of controversies since the early days of recombinant DNA research in the 1960s. Many scientific and ethical issues are discussed throughout this symposium. A particularly troublesome set of questions arises from the uses of gene technology to change personal characteristics that are within the range of normal but for which some kind of improvement may be desired. This kind of modification is generically referred to as ‘genetic enhancement’.

Almost all aspects of human form and behavior are influenced by genes. Scientists have identified many human features that could potentially be enhanced. This range of features can be categorized into three groups: physical, intellectual, and behavioral, a classification originally suggested by Hermann J. Muller.¹

Types of Enhancement

**Physical enhancements** can be divided into two subgroups, health-related and non-health-related.² Health-related physical enhancements might include genetic manipulations of the immune system both to improve functional responses to invading microorganisms, bacterial and viral, and to prevent dysfunctions of immunity, like allergies and autoimmune diseases. Some conditions are seen in nearly everyone during aging, so are, in that sense, ‘normal’; for example, presbyopia, osteoporosis, and benign prostatic hypertrophy. These normal conditions might also be modified by genetic means. Non-health-related physical enhancements include aspects of form and function like size (both height and weight have strong genetic as well as environmental components), the need for sleep, and the aging process itself. All these have strong genetic as well as environmental determinants. Tallness seems to confer certain social advantages, so increasing height to above normal might be considered desirable by some. If the need for sleep could be reduced to 2-3 hours a night, which at this time seems plausible, then an average functional day could be increased from 16 hours to 21 or 22 hours, which some might consider an advantage. Aging itself seems to have a substantial genetic component, and by appropriate manipulation of genes, most people could be endowed with capacity to live to about 120 years, the age that currently seems to be the upper limit of human life.

**Intellectual enhancements** seem feasible because many intellectual capacities appear to be related to genetic endowment. Genes have already been identified that increase storage capacity for memory.**(memory reference)** The ability to retain memory could be multiplied many times by modifying appropriate genes. General cognitive ability seems to be much more genetically complex than capacity for memory, but ultimately could also be improved by genetic means.³

**Behavioral enhancements** may be possible because a wide range of behavioral traits are known to be genetically influenced.⁴ Behaviors like agreeableness and conscientiousness are

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¹ Muller HJ. The guidance of human evolution. Perspectives in Biology and Medicine 1959;3(1);1-43


⁴ Bouchard TJ. Genes, environment, and personality. Science 1994;264:1700-1701
partly determined by inheritance, in the range of 40-60%, while the remainder is determined by other factors, like environment and personal will, or self-determination. Example of behavioral traits that some might wish to alter are aggressiveness, on the one hand, and friendliness on the other. A person prone to violence might wish to have that tendency tempered both in himself and in his children, while many people might want to increase their own or their progeny’s level of agreeableness, kindness, and friendliness. Both goals would be held by most to be praiseworthy.

Enhancement Technologies Are Not New

Much of the uneasiness most people feel about enhancement technologies may come from the belief that we have never done anything like enhancement before and are striking off in new, uncharted, and dangerous directions. Although manipulating human genes has become possible only recently, enhancement itself is not new at all.\(^7\)

We already engage in enhancement of all the physical characteristics, both health-related and non-health-related, cited earlier as potential objects of gene modification. We vaccinate against viruses and bacteria, use reading glasses for presbyopia, and take calcium supplements for osteoporosis. We extend our waking hours by reducing the need for sleep through the use of coffee and other stimulants, particularly, for example, around the time of school examinations. We enhance our children’s height and weight through such means as encouraging a healthy diet. Women preferentially select mates for tallness and strength, both to improve the chances of survival of their children (male physical stature and strength being originally a selective advantage), and to influence their genetic endowments.

We engage in enhancement of intellectual traits. We attempt to produce more intelligent children genetically by selecting an intelligent mate. We spend enormous amounts of time, energy, and money on education to enhance intellectual traits: improve analytical skills, sharpen ability to reason, and provide information to ourselves and our children. We use devices like calculators and computers to expand our intellectual power.

Behavioral enhancements are also commonplace. We choose particular methods to socialize and acculturate our children in order to improve their behavior. We instill, through training and example, traits of friendliness and kindness, and attempt to reduce or, at least, to control aggressiveness.

All physical, intellectual, and behavioral traits are in part genetically determined, and in part environmentally, experientially, and self-determined. Human beings have always attempted to enhance capabilities of their children, including the genetic means of mate selection. Gene technology will merely increase our ability to affect the genetic component of human traits and performance: specific familial genetic endowments may be enhanced more rapidly than the generations-long processes of the past, at much less expense. These technologies can achieve only part of the desired effects, because genes only partly determine them. The need for socialization and acculturation of our children, through training, education, and caring, will not change.

Should Genetic Enhancement be Banned?

Enhancement methods, including control of genetic endowment, are not new, yet, many find manipulating DNA for enhancement to be threatening. This reaction has occurred at least partly because some of the scientists engaged in genetic research have vastly exaggerated the power of genes to alter human character and life. Walter Gilbert, the great molecular geneticist, has said,\(^7\) McGee G. *The Perfect Baby*. 1997, Rowman and Littlefield Publishers, Inc., New York, 111-133
“Knowing the complete human genome, we will know what it is to be human.” vi James Watson, a co-discoverer of the structure of DNA and first director of the Human Genome Project said, “We used to think our fate is in our stars. Now we know, in large measure, our fate is in our genes.” vii The view that human beings comprise little more than their genetic endowment is simply wrong. We are not merely our genes, but also, perhaps largely, what we have made of ourselves under the influence of our families, churches, and friends. The reductionist view of human nature may produce reactive fear of abuse of that power, unjustified fear that can lead to political actions that forbid or undermine research with promise of great benefits to mankind. We see this today in the rush to prohibit genetic and cloning technologies with laws, at the federal and state levels, that threaten to expunge vast areas of useful and unthreatening research.

Genetic enhancement technology seems dangerous in another important respect: when changes are made in germ cells, the altered DNA will be passed on to future generations. Thus, any mistakes would be permanent and potentially widespread and catastrophic. This fear is not well-grounded, however; it assumes that changes in the genome cannot be reversed. It is very likely, though, that the same technology that was used to make the initial change can be used to restore the original genes. Thus, children or grandchildren who want to restore their original genetic endowment will probably be able to do so. It seems implausible that progeny whose genes have been altered will want to restore greater susceptibility to infection, to reduce the capacity for memory, to diminish general cognitive ability, or to become less friendly and kind. Any that want to restore those traits, however, will in all likelihood be able to do so by using the same methods to reverse genetic alterations that were used to produce them. It is possible, of course, that changes in genetic material could be harmful and irreversible. The answer to that potential problem lies not in foregoing all the benefits of gene research by banning it, but by effecting protocols to detect harms and to place them in the balance that weighs them against benefits.

Some nongenetic enhancements currently being used may be harmful. For example, androgenic steroids, self-administered for increasing strength and speed, may be associated with premature development of cardiac disease. By itself, this personal harm seems an inadequate reason for banning the use of such drugs in sports competition: we do not ban hang-gliding, which threatens immediate death from falls, nor do we ban professional football, which is associated nearly uniformly with chronic bone and joint disabilities. An important harm of steroid use is to the sport rather than to the individual. Steroid use may change the level of the competition itself, and pressure competitors who do not want to take such drugs to use them. To preserve the integrity of their sport, responsible authorities may want to prohibit the use of performance-enhancing drugs, both over-the-counter (catecholamines for asthma) and prescription (steroids), as well as training techniques (blood doping).

It is a long leap from supporting prohibition of enhancement agents by sports authorities to claiming that they should be made illegal. Such an action would impose criminal or civil penalties on the offending athlete, consequences that are far more difficult to justify than prohibiting him from competing. In the same way, individual physicians or institutions may have good reasons to wish not to utilize genetic enhancement technologies. Justifying legal proscription, however, would require demonstrating serious harm to others, and the existence and importance of such harm is not at all clear.

The Danger of Eugenics


The word 'eugenics' has a strongly negative connotation. The term deserves that opprobrium, earned over the last century, as documented elsewhere in this symposium. It must be understood, however, that all of the eugenic horrors of the last century were brought on by social and political programs that enforced involuntary eugenics. Widespread harm from abuses of gene technology are likely to result from the same common source: ill advised political and social programs. Such dangers can be substantially reduced by restricting the uses of gene technology to individuals and couples acting voluntarily, informed by all available information about the known benefits and harms of particular genetic manipulations.

What of the possibility that couples, even though making voluntary and well-informed choices, will make poor decisions harmful to their offspring? Such harms are not only possible, they are likely, given the fallibility of human judgment. Individuals and couples already make decisions that are beneficial, and may be harmful; for example, they make mistakes in choosing mates and in their practices of parenting, errors that can result in divorce and other harms to children. Those errors inevitably have long term effects not only on their own children, but also on future generations. Yet, recognizing the importance of self-determination, both to protect the possibility of pursuing personal happiness and to assure political stability, we do not attempt to microregulate mating choices or parenting techniques.

Gene technology has promise of great benefit and, with it, possible harm, but it should not be politically regulated any more than equally powerful enhancements we provide our children through reproductive choices and parenting should be controlled in that way. Our society is profoundly pluralistic, and no central agency can predict what changes in physical, intellectual, behavioral characteristics will be useful or beneficial to couples or to their children. With that in mind, our public policy should not attempt to provide a detailed, prescriptive ethical framework for what is permissible and what is not permissible in gene therapy or genetic enhancement. We suggest, instead, that public policy construct a nonprescriptive framework that describes the general conditions under which development of gene technology, both research protocols and practical usages, can proceed.

Framework for policy on gene technology
1. Participation in any genetic research or other programs must be fully voluntary.
2. Every participant in all genetic research or other programs must be provided full disclosure of potential benefits and risks associated with gene technologies. Consent to the use of any technique must be both informed and voluntary.
3. No political or governmental entity may engage directly in any program using gene technology to alter the DNA of human beings.
4. Genetic information regarding individuals and families must be protected with

Saunders DE. Lessons from Eugenics for the neoeugenic era. J So Carolina Med Assoc
full confidentiality and privacy, within the limits of information technology.

5. Access to gene technology must not be legally denied to any individual or group.

A nonprescriptive framework such as this has several advantages. It gives families the power to weigh risks and benefits and the freedom to make changes in themselves and their children that they find desirable in the context of their own lives. The process of developing the technologies, then discovering the risks and benefits for families to weigh in making their decisions will be slow and messy, but necessary. Such a framework also obviates the need for bioethicists to agonize over an exotic ethics of enhancement. Policies of this kind are most likely to preserve the free democratic institutions that are our best hope for preempting abuse of gene technologies by demagogues and potential totalitarians. They recognize that life itself is not free of risk, but that the weighing of risks to themselves and to their children is rightfully the responsibility of individuals. These policy guidelines affirm the pluralism and individual freedom of our society while permitting genetic research that may reach goals to which all of medicine aspires: major reductions in disease and disability, and general improvement of the human condition.
References