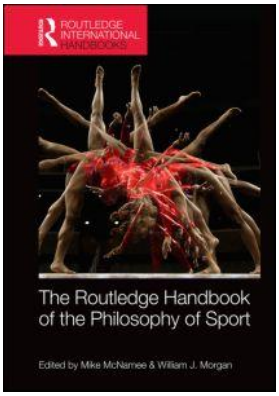

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Mike McNamee, William J. Morgan

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W. Miller Brown
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GENETICS, SCIENCE FICTION AND THE ETHICS OF ATHLETIC ENHANCEMENT

W. Miller Brown

Legacy of genetics and sports

Behind every sport is a story about genetics. Not a story about the science of genetics, or even a self-conscious awareness of the genetic basis of much that distinguishes athletes (as it does for the rest of us). But in the selection of players, in the rules of our games, and in the biases that sprinkle sports history, genetics lurks as a hidden factor. It is only in the past hundred or so years that the genetic basis of our athletic profiles and abilities has become evident. And only in the last 50 or so years have we imagined that we could begin to control the genetic determinants of athletic prowess.

This chapter reviews the prospects for genetic enhancement and its impact on sports. Several of the standard objections to enhancement of humans (whether athletes or not) are reviewed and found wanting. A further risk posed by the means of achieving such enhancement is deemed an important brake on further developments. The chapter concludes with some reflections on sports and the changes likely to result from enhancement projects in the wider population.

Our sports have always been segregated by the most significant genetic factor in human make-up: sex. Virtually all sports have, since the Ancient Greek games, been divided into those available to men and those available to women. With rare exceptions, this continues to be the case. Once in a while, a woman will ask to compete with men, and in a few cases, men, usually transformed by modern medicine phenotypically into women, will compete as women.[1] But in most cases, in sports we are almost two different species.

And in other respects as well, our sports are segregated by phenotypes whose basis is clearly genetic. By virtue of their different rules and objectives, sports present challenges of very different kinds that favor athletes with very different physical and mental abilities. Height and jumping are favored in basketball but not in gymnastics. Endurance and slow-twitch muscle fibers characterize long-distance runners and swimmers, but not sprinters or ice skaters. Bulk and musculature are an advantage in weight lifting and football, but not in mountain climbing and sailing. As a result of these differences in the demands of the sports, athletes largely self-select what sports they will participate in, honing their skills and developing their natural talents and traits to meet both the requirements of the sports and the relentless competition from other athletes. Of course, there are significant similarities in physical traits that different sports require,

but our sports cater to the wide diversity of phenotypes (and their genetic foundation) that characterize our species.

The history of "sex verification" goes back at least to the 1930s when the International Olympic Committee (IOC) began questioning the sexual identity of athletes. Routine sex tests were mandated by the Committee in the 1990s, but discontinued after 1999. Individuals, however, are still being tested. But as our knowledge of the genetic basis of athletic abilities has increased, it has also generated much confusion and injustices (Levine and Suzuki, 1993).[2] The genetic basis of sexual differences in humans is complex and sometimes defects in the control mechanisms of sexual differentiation produce individuals with variations on the usual chromosomal features of men and women. One estimate is that one in 500 people have abnormal chromosomal traits that affect their biological sexual identities (Levine and Suzuki, 1993, p. 76). This signified to the IOC in 1991 that tests for abnormal X chromosomes could be used to segregate male and female athletes and prevent genetic males, whose testosterone was thought to promote greater muscle development, from competing with genetic females. Because of the complexities of genetic variations and their effects on phenotypic traits, and because of the indignities of their use, the tests have largely been discontinued. New rules and regulations by the IOC have done little to dampen the controversies, particularly in cases of hyperandrogenism (Karkazis, *et al.*, 2012). The primary motive of their use, to prevent competition among athletes with widely different abilities due to differences in testosterone production, continues to prompt occasional genetic testing. The same motive lies behind tests for the use of exogenous hormones. But the policy issue of separating groups of athletes as male and female and its justification remains largely a relic of tradition.

There is, however, a fundamental difference between testing for genetic variation and testing for externally administered drugs such as steroids, growth hormone, and erythropoietin (EPO). Genetic variation is so far not something that can easily be created by the processes of contemporary biomedicine, although, in the opinion of some, it is not long to come. As a result, sports authorities have great difficulty deciding what to do about naturally occurring variations in human traits that are beneficial to athletic performance. For example, natural variation in levels of hemoglobin gives some people advantages in endurance sports such as cross-country skiing where oxygen transport is crucial.

Imagine a difficult case. Johan has autosomal dominant erythrocytosis that produces a (statistically) abnormal level of hemoglobin. This trait, together with rigorous training and the development of his skills, has enabled him to become a champion cross-country skier. Hans, however, has an average level of hemoglobin. He has found that taking synthetic EPO can boost his hemoglobin level to at least that of Johan and so he can, if he trains hard, effectively compete with him. Should Johan be allowed to compete, but Hans be excluded because he has used a forbidden substance to enhance his performance? Or should Johan be banned because he is a genetic anomaly whose natural traits give him an unfair advantage? Recall that the naturally occurring variation in X and Y chromosomes still forms the basis of banning athletes from some competitions.[3]

In other cases, we have chosen to ignore genetic-based variations in athletic ability such as height, strength, agility, coordination, intelligence, just as we have largely ignored the advantages of class, race, education, wealth, coaching, equipment, and medical care for the development and enhancement of athletic ability.

The controversies over the use of performance-enhancing drugs continue to rile our discussions of sports. But it is not often noted that the drugs in question are, in a sense, only first-generation enhancers. They typically act by supplementing naturally occurring substances in the body to boost various biochemical processes that can affect athletic performance. They

promote muscle growth and reduce injuries, quiet muscle tremor, lower blood pressure, and increase oxygen transport from the lungs to muscles, and much more. Their types and effects are legion. The second generation will be drugs, already available for medical treatments, that directly trigger gene expression of proteins that will have similar effects on metabolic pathways and performance ranges. These techniques are already on the horizon. Third will be genetic modification of somatic cells, already being developed for treating genetic diseases, that are responsible for the same performance ranges. (Possibly in this category will be the use of stem cells to enhance organ growth and metabolic functions.) Fourth will be modification of gametes, sperm and ova, to provide for individuals who from birth possess enhanced biological endowments. Neither of these last two kinds of biomedical processes will be self-administered; and they will cloud the attribution of responsibility when they are chosen by others than those who benefit from them.

Anticipating such developments, a number of conservative commentators have railed at what they consider to be the dangers of enhanced athletes. Michael Sandel, in his book, *The Case Against Perfection* (2007, pp. 24, 35), claims that enhancement efforts will promote "a kind of hyper-agency, a Promethean aspiration to remake nature, including human nature" that threatens "the integrity of the game." He deplores the emergence of "bionic athletes." Leon Kass, chairman of the President's Council on Bioethics, made the startling claim that enhanced athletes are "getting their achievements 'on the cheap,' performing deeds that *appear* to be, but that are not *in truth*, wholly their own."(President's Council on Bioethics, 2003, p. 145)

Some of these expressions of concern are guided by an expectation that enhancement will be primarily for "positional advantages;" that is, for short-term advantages in competition that occur when some athletes, but not all, use enhancing techniques and so gain a competitive or positional advantage. As many writers have pointed out, such advantage is not likely to last since others will begin to use similar techniques, and so rebalance the competitive scene. Thus, if parents, hoping to have children who are successful in sports, promote their children's height through genetic or other means, their goals will be frustrated as soon as other children are similarly enhanced.[4]

There is some plausibility to this concern, although it clearly applies to many different factors in competition, such as training techniques, food supplements, coaching, and equipment modifications, to name a few. There is always a tendency in competition to seek advantages that are soon countered by imitation or alternative approaches to the game. But not all such efforts at positional advantage are superficial or temporary. Many may have longer-term benefits to the sport; they may enhance not only the players' competitive edge, but modify the sport in ways that increase its challenges and satisfactions. Furthermore, increasing the height, for example, of some people to make them more competitive may be a move to increased opportunity to participation by those who otherwise would fall short in the lottery of life. Techniques for achieving positional advantage may therefore, if widely shared, have the desirable effect of raising the level of ability of those who formerly were at a disadvantage thus increasing the distribution of competitive abilities and so the opportunities for participation.

Positional advantage is not the primary focus of critics of enhancement. They see athletes, perhaps rightly, as the most publically visible exemplars of their worries about genetic change, and sports as the embodiments of their fears. Their concern is rather that such practices may undermine our sense of authenticity, of personal identity, and even our sense of what is natural to our species, more generally in sports and elsewhere. And these objections, if sustained, would apply not only to enhancements aimed at positional advantages in sports, but also to "general purpose" traits such as enhanced immune systems, cognitive abilities, and emotional sensibilities, and a variety of physical changes in the patchwork of traits that characterize the

legacy of natural selection. Some have even argued that the anti-enhancement efforts in sports is part of a more general "war on enhancement," motivated by the threat that enhancement technologies pose to those whose power and wealth rest not just on hard work, but on considerable luck and natural talent, neither of which is deserved or evenly distributed by the lottery of life. Should enhancement become widely available, thus leveling the playing field in society in general, and of sports in particular, the lucky would find their advantages, power, and wealth seriously challenged (Mehlman, 2009b).

This makes clear, therefore, that the wide and equable distribution of biomedical knowledge and engineering is uncertain. The availability of these technologies, should they be developed as some people imagine they will be, is an important matter of justice, probably on a global scale.

Accordingly, the challenge of genetic and other techniques of biomedical enhancement for sports comes not from practices aimed at athletes only, but from the quite general goal of enhancing the human species. And while the rules of sports are for the most part arbitrary, sports reside within a larger social matrix where enhancement technologies are likely to proliferate, driven both by the private interests of individuals and families, the commercial interests of pharmocogenetic enterprises, and the concerns of governments to maintain economic productivity and military effectiveness.

The case for enhancement

Many of the arguments that are made against the prospects of human enhancement echo those that are made against enhancement in sports. Indeed, the same critics of enhancement often use sports to illustrate their concerns. Michael Sandel (2007), for example, writes of "bionic athletes." A critical look at these arguments therefore accomplishes the double purpose of assessing the case against enhancement in general and against enhancement in sports in particular. In the end, it is the former that is likely to have the bigger impact on the latter.

Biomedical genetics and pharmacogenomic research are relatively new fields. Certainly, they postdate the discovery in the 1950s of the structure of DNA and rely heavily on the completion of the genome project in the 1990s. We are scarcely a generation into work in these areas that is prompting reflection on a "post human" future, a future that could result from deliberate manipulation of the human genome and our control of human evolution (Harris, 2007; Hughes, 2004; Buchanan, 2011a,b; Mehlman, 2012). On a less speculative level, we are already faced with a longer tradition of modifying human behavior with a pharmacopeia of astonishing variety. Largely rising out of treatments for medical conditions, drugs are now available for enhancing human behavior and are used widely in the military, in schools, in sports, and in our daily lives.

The drugs of choice on college campuses include Ritalin®, Adderall®, Prozac®, Zoloft®, Provigil® (modafinil), and others drugs, not to mention older standbys such as caffeine, antidepressants, synthetic hormones, and stimulants (Pence, 2012, p. 33). Moreover, the evidence is that these substances usually work, that they do indeed enhance the cognitive, physical, and psychological traits of people who use them, both those with diagnosed disabilities and those with more normal profiles. In sports, there is plenty of evidence that erythropoietin (EPO), human growth hormone, and many other drugs, including anabolic steroids, do effectively enhance athletic training and performance. We are probably witnessing the early stages of a large, unsupervised experiment in the pharmacological enhancement of human capacities. With the flourishing of stem-cell research and the prospects of genetic manipulation of both somatic and germ line cells in the human body to increase cognitive abilities, to improve our

immune systems, to increase longevity, and to begin to remedy some of the worst results of our evolutionary history, we are indeed seeing the start of what may be profound changes in human life.

Biomedical research in these areas poses risks, but they also promise great benefits. It may be the case that failure to explore this research poses even greater risks to our future than does the research itself. We are in very early stages of this enhancement project, so it is not too early to look at its prospects. Still, we are not there yet, and so we might use a phrase of Allen Buchanan (2001, p. 22) to characterize it: the "ethics of science fiction." It is sobering to note the pace at which fiction is becoming reality.

I begin by examining several lines of criticism of human enhancement in sports that I believe are ill founded. I then turn to what I consider the real dangers of clinical research on human enhancement, dangers that reflect not so much on the ends of enhancement efforts, but on the means.

The nature of enhancement

Let me begin by commenting on the nature of enhancement.[5] Here, I focus on somewhat moderate claims, those changes that are more nearly within our grasp, given current levels of biomedical technologies, rather than on forms of radical enhancement favored by so-called "transhumanists" such Nick Bostrom (2010), Ray Kurzweil (2005), James Hughes (2004), (Agar, 2010).[6] Some enhancement of our immune systems, some increase in longevity, various increases in the ranges of cognitive, emotional and physical abilities seem to me likely in the foreseeable future. Immortality, uploading personalities into computers, the successful creation of cyborgs, and vast increases in cognitive and other abilities, seem to be far away.

But, first, there are a number of conceptual issues that need clarifying. Enhancements are generally understood to be improvements in normal capacities, or augmentations of normal abilities and traits that are typical of our species. Biomedical substances for performance enhancement in sports and colleges are familiar instances. But there are two problems that arise immediately with this broad characterization. First, how are we to distinguish such biomedical enhancements from other kinds of enhancement in a way that shows an ethically relevant difference? Second, can we distinguish biomedical enhancements from medical treatments of disease, disability and injury?

Consider the second problem, the distinction between treatment and enhancement (Frankford, 2007; Buchanan, *et al.*, 2001; Juengst, 2007, 2009). I am dubious that this distinction can be usefully maintained for several reasons. First, many treatments result in enhanced capabilities, not just repair of injury or remedying of illness. Second, much standard medical treatment is designed to enhance our ability to cope with our environment: vaccines boost our immune systems, beta-blockers improve our cardiovascular health, prophylactic antibiotics prepare us for microbial assaults, fluoridation of water strengthens teeth, and well-baby care prepares children for stronger responses to their environments. And, in the future, genetic medicine will both serve to remedy mutations causing disease, and to enhance at the same time our genetic profile. So we can anticipate two kinds of enhancement: bringing many people up to normal levels of ability or even up to the extremes of current natural variability, and also effecting improvements beyond current human levels.

But some people use the distinction to reject prospects for enhancement. Michael Sandel, a Harvard political philosopher, has made the claim that we should reject enhancements but not treatments on that grounds that "healing a sick or injured child does not override her natural capacities but permits them to flourish" (Sandal, 2007, p. 46). He seems to ignore the fact that

one's natural capacities may be limited and their flourishing could be enhanced not only by curing illness but also by extending the range of their uses. The key word here is "override." Sandel writes as if enhancing would eliminate one's natural ability rather than extending its scope. If I have a natural ability to throw a baseball and extensive training extends that capability, we would not see it as being overridden, or that my enhanced skill is perverting nature. Further, enhancements, as well as treatments, may permit our abilities to flourish. For example, if we extended the human life span (an enhancement indeed) our natural abilities would have more time to flourish (Kamm, 2010; Brown, 2009).

But the first problem (distinguishing biomedical enhancements in a morally relevant way from other kinds of enhancements) suggests an even greater difficulty. Human history is in some ways the story of the development of practices and technologies that enhanced our abilities and capacities. Literacy, agriculture, economic and political systems, and inventions from the stirrup to computers are all enhancements of human powers.[7] These technologies have influenced our biology as well as modified our environments, for example, in the selection of lactose tolerance as adaptable to dairy farming and in the reprogramming of the microstructure of our nervous systems that accompanies literacy and numeracy. There is even some evidence that activation of the expression of various genes by environmental influences is heritable and so some environmental changes during embryonic development may have a profound effect on us.

Nature, human nature and the natural

Among the arguments against enhancement that figure most prominently in writings of conservative critics (such as Michael Sandel (2007), Francis Fukuyama (2002), Leon Kass (2000), and Jurgen Habermas (2003)) are ones that rely on concepts of the natural. Although there may be something valuable in their claims, they rest, I believe, on fatal flaws. Consider first the concept of nature.

The argument here (as we saw in the passage from Sandel) is that tinkering with nature, a kind of sacrosanct given, would not only damage the order of the world, but would deny in us a respect and appreciation for the given in our lives (or as Sandel refers to it, the "giftedness" of features of human life). In sports, the concern is that the creation of "bionic athletes" (Sandel's term) would produce athletes whose achievements mock the striving for excellence that characterizes the challenge of sports. Athletes' accomplishments would no longer be due to arduous training and flinty determination, but the artificial enhancements of biomedicine.

There is little that is persuasive in this view. Even with enhancements, athletic achievement would require the kind of effort, skill and training that is already the mark of great athletes, even those whose abilities and phenotype place them at a far extreme of the spectrum of human variation. Shifting that spectrum would scarcely reduce the need to develop whatever "given" is an athlete's starting point.

And, of course, we tinker with nature all the time. Indeed, when it comes to protecting ourselves against the forces of nature that damage and harm us, it is urgent that we do so. Modern medicine and public health, for example, are designed to modify the vagaries of nature that threaten our wellbeing. Whether we do so wisely and with good consequences does not depend on understanding any infringement of the givenness of nature, but on a careful examination of the results of our actions.

Nevertheless, these same writers often focus on our own natures as a basis for admonishing us not to undertake efforts to change these natures. Here, they rely on a long, controversial history of philosophical claims about human nature, first generated by Aristotelian essentialism,

a history that offers little hope that their claims can be substantiated. Even Aristotle's vaunted rationality is no longer seen as the sole purview of humans.

The importance of an immutable or essential concept of human nature to those opposed to enhancement is that it might seem to offer a basis for ethical objections to any changes in that nature, and can be used as a standard for regulating participation in sports. Aristotle argued that what is good for humans is what is in accord with our natures. Accordingly, there ought to be a central place in our lives for the pursuit of rational activities such as philosophy. But the good and the natural are different categories and do not necessarily overlap. We know much in nature to be bad, and much that we value in modern medicine, for example, is far from natural.[8]

Contemporary evolutionary biology offers quite a different picture. We are a product of adaptation, of reproductive fitness to our environment (Buchanan, 2011a). And it is clear that not all of the traits we have acquired by natural selection are good ones. Our ability to reason is deeply flawed (Stein, 1996); our capacity for aggression and xenophobia are notorious; our arteries harden, our eyes weaken, our teeth decay, our bodies succumb to disease and are all too easily injured, our bipedal stance leads to hernias, backaches, and difficult childbirth. It only matters to mother nature that we survive long enough to produce children who themselves are likely to have as many defects. But it matters more to us. No moral objection follows, as far as I can see, to efforts to remedy our defects and to strengthen our better natures. So, too, for sports. Efforts to yoke sports to a concept of the natural has produced the very degrading morass of sex differentiation that has plagued Olympic officials (Karkazis *et al.*, 2012). We know enough, too, of efforts to discriminate among athletes based on race to be wary of any recourse to what is deemed natural.[9]

Psychological risks of enhancement

Critics (Sandel, 2007; Kass, 2000; Fukuyama, 2002) have argued further that enhancement threatens relatively stable features of human psychology. Included among these concerns is that such efforts will cater to a willful quest for mastery and thus reduce our sense of humility and tolerance for the frailties and limitations that are part of human life. But this is surely what athletes often strive to do: to master their sports, to develop their skills and capabilities far beyond the norms of human life.

Of course, even if it were true that the motivations of some who seek to enhance athletic achievement include a willful desire for mastery, Sandel does little to show that such a desire is incompatible with other virtues such as kindness, generosity, sportsmanship, and even a realistic sense of humility in face of one's limited ability to achieve greater levels of mastery. In any case, even if such a desire were deemed a vice, it does not follow that enhancements would be bad for us or that we would be better off without them.

Similarly, there seems to be no plausible case for concluding that efforts to enhance human life in general or athletic achievement in particular would inevitably lead to a loss of a sense of responsibility or solidarity or that it will undercut our "openness to the unbidden" (Sandel, 2007, p. 45). One can possess mastery without desiring to have it for its own sake; for example, developing mastery for the sake of goods that mastery makes accessible. One could master some things while remaining open to the unbidden in other areas, or even in an area one imperfectly masters. And even if mastery were an evil disposition, a kind of vice, seeking good results as manifestation of that mastery, say the cure of diseases, or the extension of human life, or great achievement in sports, would surely be morally permissible: bad people can do good things. We can be fully aware of what Sandel (2007, pp. 26–9) calls the "gifts" (or good things) of life, even being grateful for them, while seeking to improve them or augment them.

More generally, one might wonder how Sandel and other critics can single out biomedical enhancements for condemnation and not, by the same reasoning, condemn other forms of cultural enhancement which have included the mastery of writing, farming, mathematics, science, and an astonishing variety of technologies such as flight, computers, telecommunication, and medicine, which have greatly enhanced our abilities and arguably have changed us for the better. In sports, it is hard to find consistency in condemning biomedical enhancements and yet allowing the enhancements of diet, equipment, coaching, training, and the reliance on the unusual extremes of human phenotypes already central to elite sports.

Seeking mastery in their sports is a central trait of athletic accomplishment. There is little else so common to virtually all sports as the constant desire to improve even if it is only to improve one's own personal best performance. Seeking positional advantage is in some ways the heart of sports (Brown, 2001). Athletes do it by adjusting diet, modifying equipment, seeking better coaching, changing their training environments, and studying the processes of human physiology. They often do these things in the spirit of sport, often with increased effort, determination, and feelings of solidarity with their fellow athletes and a sense of responsibility to themselves, their fans, their teams, and the goals of their sports.[10] There is often pride in their achievements, but similarly a sense of their limits, a humility in face of the achievements of others that is not dampened by their efforts to do better.

Let us return to the criticism that enhancements that only achieve a positional or competitive advantage are immoral. Usually, this position is based on the fatuous, though true, claim that such efforts are frequently against current rules (Pence, 2012).[11] What is not noted is that it is precisely the rules themselves that are in question. More often it is noted that such efforts are potentially futile. If everyone tried the same things, no one could achieve a positional advantage. The favorite example is medical intervention to increase the height of children who either suffer from growth hormone deficiency or simply fall on the lower level of the normal height distribution curve (Sandel, 2007, pp. 16–19; Buchanan, *et al.*, 2001, pp. 115–16). If everyone were to be of roughly the same height, no one would benefit from the value our society places on height, although it would assure every one of the same opportunities that height may now confer on some. But this is not what the enhancement debate is primarily concerned with. Rather it is with what some have called "general purpose enhancements" that would be of value even if, perhaps especially if, everyone had them: increased cognitive abilities, more powerful immune systems, longer, healthier lives, and greater propensities to social cooperativeness. It is true that an unequal distribution of such enhancements would also create positional advantages and so raise serious questions of distributive justice. But if widely available, they would tend to create broader social benefits of productivity and creativity. There is nothing, so far as I can see, that morally privileges the normal which already includes an unequal distribution of traits as a result of the natural lottery of life (Bostrum and Ord, 2006). It is largely the individuals who far transcend what Norman Daniels (1985) has called "species-typical functioning" that fill the ranks of elite sports.

Finally, there is the claim that the enhancement project threatens to undermine our efforts to live authentic lives. Or even that it may undermine our sense of personal identity. Fears about inauthenticity are not new (Trilling, 1971; Taylor, 1991; Eliott, 1998). We will not benefit, it is claimed, from the hard tasks of coping with life's sorrows and limitations if these experiences are mollified by biomedical means.

Of course, there is not much evidence for any of these claims – except for the character transforming experiences of a non-biomedical kind: religious and political indoctrination, psychological trauma, education, and the profound influences of family and friends. So, yes, there is some basis for worry about personality-changing enhancements. But there is little

justification for claiming that athletes would lose their ability to make authentic choices or to control those parts of their lives that are open to the rest of us. Just as in the case of other influences, if choices to use these enhancements follow from core traits of one's personality, if they were chosen voluntarily and with reflection, why would they not be authentic? It is true that we should value our best traits, that we should beware of radical and frequent efforts at self-transformation, but none of these concerns is unique to prospective biomedical interventions in the lives of athletes. Nor is inheriting exceptional traits, whether through biomedical intervention or not, a barrier to authentic living, though for all of us it does partly shape our identities as athletes and in other parts of our lives.

The real dangers of the enhancement project

The problem is that not all change is benign. Many of the objections I have discussed have shown little merit. Enhancement technologies are not new in human experience in general or sports in particular, or limited to biomedical processes. Nevertheless, there are salient differences in using new biological means to achieve the old ends of improving human life and athletic performance. I now want to consider some of the dangers inherent in these new technologies.

For the most part, the back door to enhancement research lies in the development of the treatment of disease and illness. In spite of my discounting the treatment/enhancement distinction as a good basis for drawing firm lines against biomedical enhancement research, it nevertheless offers the surest basis for assessing risk. Although they are fallible, and liable to the same pressures for fame and fortune as many medical enterprises, risk assessment protocols in therapeutic medicine offer a framework for discussion of the risks of biomedical enhancement. The problems I consider here are in regard to the means, not the ends, of the enhancement project. I return later to a renewed consideration of the how those ends will transform sports.

The risks of clinical research

Clinical research is the opening for enhancement medicine since many of the frontline procedures such as drug development to correct metabolic deficiencies and gene modification for serious diseases are likely to provide the techniques for both drug-based and genetic enhancement in sports. Unfortunately, the ethics of clinical research are far from straightforward. To show this, I want to consider briefly some of the categories of subjects that present the main ethical problems for clinical research. Our ethical precautions about their care can provide the matrix for the ethics of enhancement efforts in sports.

Almost all current medicine is directed toward treatment of people suffering from injury and disease, but what is learned in doing so is clearly a step toward enhancement medicine. In addition to adults, two other groups of subjects for this research are especially important: children and prenatal embryos and fetuses. A further category is research on germ line cells; that is, sperm and eggs.

My main concern is with the protections afforded such subjects, and what risks may be warranted in light of reasonable expectations of benefits. If we can proceed with such research with reasonable precaution,[12] the effects on sports may be significant.

Adults

The central problem for clinical research is determining when it is permissible to subject people to risky research for the benefit of others, either other people in the future or the

researchers themselves (Wendler, 2012). The traditional solution to this problem is that subjects must give fully informed consent. This classic principle of autonomy faces the daunting task of overcoming much skepticism about the level of informed consent most subjects, and athletes in particular, are capable of achieving and so understanding what risks of pain and injury they may face.[13]

We currently, if reluctantly, allow subjects to participate from a variety of motives; for example, giving something back to society, seeking to benefit future generations, or as providing a form of personal charity. And of course, perhaps the strongest motive of all for those already desperately ill: The great likelihood of death if nothing is done at all. But we also place constraints on researchers: Some kinds of research are impermissible, even if subjects consent, because they are excessively harmful, degrading, or scientifically specious. The empirical problem is getting a good grasp of what the risks and benefits are so that people may judge when participation may on balance be a reasonable choice.

But let us suppose that we can cope with these problems. We redouble efforts to inform potential subjects, eliminating those who appear not to grasp the basic strategies of the research, particularly the risks of random assignment of test procedures and its implications for their own conditions, and allow that healthy subjects may sometimes grasp the potential harm they face and nevertheless accept it for altruistic or other reasons. We monitor research protocols through independent review agencies for types of research that are deemed morally impermissible. And we put into place strong regulations against using easily exploited subjects, regulations that protect the poor, needy, sick, uneducated, and deluded. We might even explore the possibility of allowing people to risk some dangers in return for significant benefits as we do in the workplace: financial payments, general health care, treatment for injury, and a measure of respect and protection from unnecessary danger.

And we regulate carefully other potential subjects that pose even more difficult ethical concerns: those who need emergency treatment, or who are comatose, senile, or terminally ill and so whose informed consent is not possible or not well-founded. Where the risk (or even imminence) of death or serious debility is great, consent can be obtained, and prospective benefits are considerable, there may be some cases of permissible involvement of such patients in non-therapeutic research. But we know enough of the horrors of unregulated research on such patients to be wary of any loosening of oversight and regulation of their care.

Children

If we are reasonably confident that we can allow research on adults, we can now turn to our concern for our children. Much of the dream of enhancement has to do with changes in our abilities to cope with and improve our interactions with the natural world and other people. And these changes are often conceived as beginning with modification of embryos, fetuses, and children. Here, too, there are standards of care and limits on permissible research that are useful guidelines.

Clearly, the requirements of informed consent that we saw were problematic even for adult volunteers now devolve onto surrogate or parental consent for children. There have been both successes and failures in gene therapy (Grady, 2012, 2013; Stolberg, 1999). Further research on gene replacement is advancing rapidly and it is likely soon to become widely available. Whether and how these techniques may affect athletic performance is not clear. The central challenge, however, is not likely to be their use for "positional advantage" but their ability to enhance "general purpose" capabilities for children who will subsequently embark on athletic careers.

In the United States, federal regulations on human experimentation are codified by what is called the Common Rule, based on a 1979 report (the "Belmont Report") by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. It has been adopted by 15 federal offices and agencies (US Department of Health and Human Services, 2009) The National Academy of Sciences also has extensive protocols on risk and benefits in research on children that mirror to some extent those for adults (Field and Berman, 2004). None of these regulations explicitly refers to enhancement experiments, but none explicitly forbids them.

Germ line research

Finally, we come to the heart of the matter. What changes to human germ line cells or gametes can be justified? It is these changes that could affect the general population, that portend the most likely changes in athletic prowess in the near future and so will most dramatically affect sports.

So far, as I have suggested earlier, these developments are mostly in the realm of science fiction, but the prospects of biomedical research in this direction are real. If genes can be inserted into somatic cells, they can be inserted into germ cells. If we can tinker with bacteria and plants, we can surely graduate soon to primates. Indeed, some fantasize about creating entire new chromosomes that will carry genes to power many enhancements of human capabilities. Once again, all of the arguments I have considered come into play: It is against nature; it threatens human nature; it will commodify us for the sake of research; it will threaten our ability to live authentic and humble lives; it will threaten to create a new species of superior post-human beings who may not care about the current sorts of people like us.

My sympathies are with those who reject these dire projections. But in light of my emphasis on the risk of harm, what harm in the short-term can come from biomedical germline research of this sort? If we could produce individuals with more powerful immune systems, more robust cognitive abilities, and greater capacities of empathy and social cooperation, who could object? But along the way to this self-controlled evolution, we are likely to make many mistakes. Iatrogenic mistakes (Stolberg, 1999) are surely not unique and similar unintended errors are likely to occur in any germline transfers of genetic material as well, although, as with many technologies, as our knowledge grows, these risks may significantly lessen.

One standard for precaution in this regard may be to consider acceptable risks as those equivalent to those if daily life or the risk of defects in normal births (Baruch, 2005). If, on the basis of animal studies and simulations, we could have reasonable expectations that efforts to produce enhanced individuals were no more risky than normal births, our research could be deemed acceptable, especially if we were persuaded that the likely benefits were great, just as we are with some of the risks of daily life. But this standard may set the bar too low, especially if we do not know how to provide for our mistakes – after they have been born.

Even if we accept a high level of risk, it needs to be offset by probable benefits. What are these? Are there any positive reasons to seek enhancements that outweigh the likely risks? Perhaps we are obligated to implement enhancements if possible to help insure human survival in face of global warming and social conflict, or to increase our inventiveness and creativity to cope with other problems. We may no more be able to afford not to seek enhancements than we can afford not to educate, or pursue technological innovation (Savulescu, 2001). But we must beware not to be driven by some vision of human progress that runs rough shod over the misery of those who will be harmed along the way.

So suppose we begin cautiously: We start by enhancing some particular trait, if we can do so safely, perhaps only to a level equivalent to the "highest" normal variation of that trait. Then we could move on to enhancements beyond the current maximum level of some trait such as memory or other cognitive abilities, immune responses, or empathic range.

For more extensive enhancements, a number of "cautionary heuristics" have been proposed to limit harm (Bostrum and Sandberg, 2010). These include targeting genes that function at the end of ontogenetic development, not ones activated early in embryonic development; intervening in ways that are limited to single individuals; intervening in ways that are reversible[14] and that entail no major morphological changes.

The basic issue is to protect future children (and athletes) from harm. So, here again, we must ask if the risk of harm is commensurate with the likely benefits that the genetic changes may engender. How much freedom should parents have to decide what risks and benefits are acceptable? What do parents owe to their children?

United States' law and tradition allow a great deal of freedom for parents to choose how their children will be treated. As part of a larger right to reproductive freedom, this control has been acknowledged (for example, in *Roe v. Wade*) to be extensive (Robertson, 1994). But it is not without limits. Drawing on legal precedents, and a long tradition of reproductive freedom, Maxwell Mehlman (2012, p. 168), an attorney and bioethicist at Case Western Reserve University, notes that, "Legally parents can do anything they want to their children so long as their actions do not amount to 'abuse' or 'neglect.'" He has proposed a general rule for governing biomedical efforts to effect germ line enhancements:

> Parents should be allowed to genetically engineer a future child except in ways that no reasonable parent would choose or that would expose the child to a substantial risk of serious bodily or mental harm or impairment that is not outweighed by the potential benefit to the child.
>
> *(Mehlman, 2012, p. 173)*

But how could such a rule be enforced? A variety of suggestions have flooded the literature. European countries have created state regulatory agencies and laws controlling various kinds of research. In the United States, in addition to guidelines such as those of the National Academy of Sciences, and federal agencies such as the FDA, the Belmont Report (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979), the *Federal Policy for the Protection of Human Subjects* (US Department of Health and Human Services, 1991) is the controlling policy. These guidelines are regularly applied, if not always assiduously, by institutional review boards that are federally mandated for all human subjects research. Ronald Green has suggested oversight by institutional review boards, and regulatory agencies like the Recombinant DNA Advisory Committee, established by the National Institutes of Health in 1974 (Green, 2007). Their rules were revised in 2007 and 2013 (National Institutes of Health, 2013). Allen Buchanan has proposed a "Global Institute for Justice in Innovation" both to regulate biomedical enhancement projects, and to insure that their results are fairly distributed throughout the world's populations (Buchanan, 2011b).

The future of sports

Clearly, we are groping in the dark, seeking both to foster biomedical research and to prevent the worst abuses we fear from it: harm to research subjects, unjust distribution of its risks to the poor and vulnerable and of its benefits to the rich and powerful.

In many ways we are like Otto Neurath's sailors, compelled to rebuild their ship at sea, plank by plank, out of its own best components, without benefit of dry dock (Quine, 1960; Glover, 2006). Our judgments about what values and traits to change, what ones to amplify, can only be based on the values and beliefs we begin with at present. But there need be no fixed nature, no standpoint outside our human experience, from which to begin, only the use of those qualities we now share, however limited and fallible they be.

Clinical research on biomedical enhancements under some of the conditions I have discussed is nevertheless, in my judgment, morally permissible and should continue. Research that is motivated by individual and family interests, corporate profit, government programs, and professional ambition is likely to go forward at a faster pace in spite of serious ethical deficiencies of inadequate consent, exploitation of subjects, and harm to individuals. But, barring major catastrophes of various kinds, enhancement projects have the potential to transform human lives for the better. Not soon perhaps; but it will come. In the end, it may be those enhancements that are our best bet to ward off catastrophe. And it is those enhancements that will have the major impact on athletic performance and sport.

Why not be satisfied with who and what we are? To accept our lot is clearly the message of the conservative critics of biomedical research and of those who fear changes in sports. One answer to this is that it is too late, and in any case, the research is scarcely distinguishable as a part of our long history of medicine in improving human lives. Another is that in spite of the evidence of our reproductive success in populating the globe and eliminating most of our competition, or perhaps because of it, we are a fragile species. Our best hope of continued survival may lie, ironically, in the evolutionary imperative of change, perhaps even change that renders our descendants quite different from us, but change that we cannot wait for nature to engineer. We must seek to make those changes ourselves so far as we can and consistent with our moral and ethical precepts. The great struggle will be to insure that these changes, like other new technologies, are fairly distributed to everyone, not limited to the rich and powerful. Likely our students today, and certainly their children, will know how it turns out.

I have only touched on the prospects for near-term biomedical enhancements. Some argue for more far-reaching developments resulting from biomedical control of human evolution. The result, they prophesy, will be transformation in the human species, new "bionic" athletics, the creation of "post-humans" or of a "transhumanist" civilization in which both new forms of animal life and of artificial life will proliferate and dominate. What place there might be for *Homo sapiens* in the long term is the subject of much speculation. So far such speculations belong largely to the realm of science fiction. But more modest changes are already available to us and will probably be a significant factor in the lives of our children and grandchildren. What will these changes in the availability of enhancement technologies do for the microcosm of sports, embedded as it is in the larger society where these changes will likely flourish?

After World War II, the development of concern for drugs in sports was strongly boosted by Cold War politics and the use of international sports competitions to further the ideological agendas of democratic and communist regimes. Anti-doping policies were also shaped by the "war" on recreational drug use (and its clandestine economic base) by the US government. Following actions by the US Congress in 1988 (and in later legislation) to criminalize the non-medical distribution and possession of steroids and human growth hormone, the war against doping in sports and the government's war on drugs merged (Mehlman, 2009b, p. 144). The police power of the state and the regulatory function of US Anti-Doping Agency (USADA; most of whose budget is funded by Congress) were partially combined. This merger raises sobering concerns not only for the autonomy of physicians to practice medicine, but for citizen autonomy as well.

Nevertheless, as we have seen, it is not likely that restrictions on enhancement technologies that arise out of medical research will foreclose their use by many people, though safeguards are clearly needed. There is even reason to believe that governments will find a compelling interest in allowing them to flourish. But limitations in sports are another matter. Regulation of enhancement techniques in sports, primarily at the present time of drug use, is largely voluntary, its support by Congress and international sports organizations notwithstanding. Because it is highly selective, it is also largely arbitrary. Sports organizations and national regulatory bodies like USADA can continue to control the conditions under which participants can play. And, of course, schools and universities will no doubt both follow professional sports organizations and attend to their special concerns with juvenile athletes. In short, whatever happens in the larger society, sports could for a time remain enclaves free of certain kinds of biomedical enhancement influences.

But if enhancement technologies proceed to develop at their current rate, and their use proliferates, then the larger society will change and bring a variety of pressures on sports to do so as well. I will not speculate on "bionic athletes," whatever these might be, or cyborg games, although I can imagine them. But I believe we have some basis for speculating on the gradual changes in sports that a change in our larger society would entail. Our sports have already changed over the years as various enhancement techniques have become available: new equipment and facilities, better coaching techniques, biomedical and psychological assistance in training and practicing, nutrition counseling, and the greater health and resources of the general population. But perhaps more important for some sports has been the active seeking and recruiting of potential athletes whose natural abilities and phenotypes place them at one extreme of human genetic variability. Variations in maximal oxygen uptake, types of muscle fibers, hematocrit levels, height, visual acuity, and coordination vary widely and can be identified as positional advantages for athletic competition. Several national sports organizations actively seek recruits for Olympic games from among those with ideal phenotypes for particular sports. The selections have produced profound changes in the sports themselves and effectively made the "playing fields" uneven for many people.[15]

A number of tactics are therefore open to sports organizations faced with a general population that embraces the enhancement technologies of drugs and genetic engineering. First is the old standby of divide and conquer. Just as participants are segregated by sex and size and sometimes by age and disability (although no longer by race), they could also be segregated into those who are the product of biomedical enhancements and those who are not.[16] The vast enforcement regime now being used by USADA and the World Anti-Doping Agency (WADA) would be needed to mark the boundaries between the two. But many enhancements will not be ones chosen by athletes, but rather chosen by their parents, so, like those with natural genetic variations or mutations, the athletes cannot be designated as rule breakers and outlaws (Schneider, 2005). Sports organizations will need to justify their exclusions from team rosters or simply set arbitrary cutoffs on certain genetic or physical traits for participants as is now done for hematocrit levels as a way of checking for use of EPO and for sexual traits. They will need to offer cogent defenses of such approaches to meet objections of arbitrary bias and exclusion.

Fearful of the changes that challenge such segregation, sports organizations can follow the usual last ditch stand: they can appeal to the "spirit of sport." WADA's appeal (quoted in Juengst, 2009) to this spirit as "the celebration of natural talents and their virtuous perfection" falls prey to several problems. Once again it appeals to a limited and normative concept of the natural. It cannot easily account for those whose inherited abilities are the product of the choices of earlier generations rather than their own. It has little to offer in clarifying the policies dealing with genetic variation that already advantage many athletes or disadvantage those deemed to

be deviant from current norms. It seems further to have a very limited view of sport as characterized by competitive and hierarchical rankings, thus ruling out ice climbing, hang gliding, sailing, hunting, and many other forms of sporting activity. It falters in its prescriptive recommendation on a covert appeal to an essence of sport.

A more likely scenario is that sports will gradually change, embracing new ranges of ability and perhaps the welcome result that more and more people will have the capability of competing at a high level, no longer being limited by the vagaries of the lottery of life.

Notes

1 But not always: Herman Ratjen impersonated a female high jumper in the 1936 Olympics, possibly under Nazi influence, and lost! And in a few sports, for example as jockeys in horse racing, men and women participate together.

2 The recent case of Caster Semenya, who competed as a female middle-distance runner, is a case in point. See Wikipedia article: http://wikipedia.org/wiki/Caster_Semenya (accessed October 20, 2014); see also Karkazis *et al.* (2012).

3 The most well-known case is that of Finnish cross-country skier Eero Mäntyranta. See the Wikipedia article "Eero Mäntyranta": wikipedia.org/wiki/Eero_Mäntyranta (accessed October 20, 2014); see also Malcolm Gladwell, Man and Superman: In athletic competitions, what qualifies as a sporting chance? *New Yorker*, September 9, 2013. Available online at www.newyorker.com/magazine/2013/09/09/man-and-superman (accessed October 20, 2014); de la Chapelle *et al.* (1993).

4 There are ethical concerns as well; see Joel Feinberg (1980).

5 Virtually all the literature explores this concept; see, especially, Juengst (2007); Savulescu and Bostrum (2010); Harris (2007); Murray (2007).

6 See also Miah (2004) for a more moderate view.

7 Michael Jones, chief technology advocate at Google, claims, "effectively, people are about 20 IQ points smarter now because of Google Search and Maps." James Fallows, Google's Michael Jones on How Maps Became Personal, *Atlantic*, January 3, 2013. Available online at www.theatlantic.com/technology/archive/2013/01/googles-michael-jones-on-how-maps-became-personal/266781 (accessed October 20, 2014).

8 These and a number of related issues are discussed in Tolleneer *et al.* (2013).

9 Erik Juengst offers a useful review of some of these issues in Juengst (2009).

10 And for fame and fortune – professional athletes gain much in social status and wealth by their achievements.

11 Pence writes (p. 57), "I believe that the link between enhancement and cheating is the master philosophical question of all enhancement ethics."

12 I allude here to the so-called precautionary principle, originally formulated for environmental concerns and often extended to other activities whose risks are not known; Rio Declaration on Environment and Development, United Nations Conference on Environment and Development, Rio de Janeiro, June 3–14, 1992. Available online at www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163&l=en (accessed October 21, 2014).

13 Hans Jonas long ago struggled with this puzzle and concluded that upending our usual selection of research subjects could solve it; see Jonas (1974).

14 Some techniques for doing this have been developed by Nobel laureate Mario Capecchi of the University of Utah. See Green (2007) for a discussion of Capecci's work.

15 Since 1949, the average height of professional male basketball players has increased from 6 foot 4 inches to 6 foot 7 inches, and average weight by almost 25 pounds; see www.apbr.org/apbr-faq.html (accessed October 21, 2014).

16 Maxwell Mehlman (2009a) has suggested segregation of athletic performance by "natural ability" whether "inherited or installed" measured by "a sophisticated combination of phenotype and genetic markers" (p. 222).

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