A LITTLE LOWER THAN GOD

WHAT SHOULD LIMIT OUR EFFORTS TO REDESIGN HUMANS?

By Einer Elhauge
Petrie Professor of Law
Harvard Law School

Founding Director
Petrie-Flom Center for Health Law Policy,
Biotechnology and Bioethics

CHAPTER 1. INTRODUCTION

> O Lord, our Lord, ... what are mere mortals that you should think about them, human beings that you should care for them? Yet you made them only a little lower than God ... You gave them charge of everything you made, putting all things under their authority...
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> *The Bible*, New Living Translation, Psalm 8 (2007).

The Beta-Blocker Puzzle

Kim Jong Su's confrontation with the limits we impose on efforts to redesign humans came suddenly and destroyed his life. A slight, modest-sized man, he had burst on to the Olympic stage as a lad of merely 17, winning the bronze medal in the 50 meter free pistol at the 2004 Olympics. He was determined to do even better at the 2008 Olympics, and he did, posting the second highest score in the world on August 12, 2008. In photographs, you can see him looking so happy that day, a somewhat dorky smile on his face, but beaming with a pride that seemed to shine throughout his body. In his excitement, he held up his silver medal so high that you were worried he might choke himself, because he seemed to have forgotten that the strap was still around his neck.

Three days later, it was all over. On August 15th, the International Olympic Committee stripped Kim Jong Su of his silver medal after he failed his drug test. He hadn't taken steroids or any of the other drugs that make athletes stronger or faster. Rather, what he had taken was a beta-blocker, a drug used by tens of millions of Americans, usually to treat heart problems and high blood pressure. But beta-blockers also have another effect. They reduce trembling, which is highly useful when you are trying to hold your hands absolutely still while aiming at a distant target. One study found that using beta-blockers increased the scores of shooters by 13%. This benefit of beta-blockers had led the International Olympic Committee to ban the use of beta-blockers for shooting or archery.

Losing his silver medal was the least of Kim Jong Su's worries. News stories after the event reported that when Kim Jong Su returned to North Korea, he faced disciplinary punishment from the North Korean sports committee, which included a high possibility of imprisonment and labor training. An inside source from North Korea darkly observed, "If you humiliate the country like Kim Jong Su did, you will be secretly dragged somewhere and suffer." As far as I can find, he has not been heard from since.

But what, exactly, was wrong with Kim Jong Su reducing the trembling of his hand by taking a medicine used by millions of others? True, he cheated by breaking the rules of his sport. But that just begs the question of why the sport should have a rule that bans this method of improving performance.

To put the question more pointedly, if it is cheating for Kim Jong Su to improve his shooting performance with beta blockers, why isn't it cheating for classical musicians to improve their performances with beta blockers? Consider the case of Kenneth Mirkin. He began studying the violin at age 12 after falling in love with a recording of Tchaikovsky's Violin Concerto, switched to the viola at age 14 because he was drawn to its warmer sound, and decided to become a professional classical musician at age 15. His parents were horrified. Sure he was going to starve, they tried to discourage him from practicing so much, so he silently practiced while watching television, and says he "actually learned the technique of vibrato while watching *I Love Lucy*." Overcoming his parent's objections, he went to Julliard and ultimately won a spot as a violist for the fabled New York Philharmonic. His successful career has included releasing a record and playing Mahler symphonies with Bernstein. In short, he proved his parents wrong by being triumphantly successful as a classical musician.

But Kenneth Mirkin could never have succeeded as a classical musician without using beta-blockers as a performance-enhancing drug. As he recounted to the New York Times, "I was the kid who always sat last-chair viola"; the reason was that his bow "bounced" during auditions. Frustrated, he wrote to Charles Brantigan, a Denver vascular surgeon who in the late 1970s had researched classical musician usage of Inderal, a beta-blocker. In 1980, Dr. Brantigan sent him a controlled study showing that taking Inderal led to classical music performances that judges rated superior to performances on a placebo. Kenneth Mirkin borrowed some Inderal from his father, who used it for angina, and took 10 milligrams one hour before his audition for the New York Philharmonic. This time, his audition was a success. He acknowledges, "I never would have had a career in music without Inderal."

Kenneth Mirkin's admission of beta-blocker usage was splashed across the pages of the New York Times in 2004. Was he disgraced and stripped of his position in the same way that Kim Jong Su was? No, today he is still a violist on the New York Philharmonic, where he continues to play sublime music. You see, in classical music, there is no rule against using beta-blockers to enhance performance. Nor is Mr. Mirkin's usage at all unusual. A 1987 survey by the International Conference of Symphony Orchestra Musicians found that 27 percent

of its musicians used beta-blockers.[1] The same New York Times article reported that by 2004 the percentage had become much higher, with beta-blocker usage by classical musicians now "nearly ubiquitous."

To be sure, there has been some grumbling about the use of beta-blockers in classical music. Some musicians complain that beta-blockers make music "technically correct" but "soulless and inauthentic." But that seems hard to square with the fact that in a double-blind controlled study (where neither the musicians nor judges knew when musicians were taking beta-blockers or a placebo), the judges thought the performances were better when beta-blockers were used. It is also hard to believe that so many musicians would take beta-blockers if doing so actually worsened their performance.

Others think the usage of beta-blockers by classical musicians is simply unethical, precisely because it seems so similar to the use of performance-enhancing drugs in sports. But these ethical claims have never been strong enough to result in any rule prohibiting musician usage. The widespread usage in classical music also suggests that ethical concerns have not even produced a strong social norm against it.

The difference in results seems too stark to explain as mere happenstance. Kim Jong Su is found to have used beta-blockers to enhance his pistol-shooting performance, and is disgraced, stripped of his medals, and possibly imprisoned or worse. Kenneth Mirkin admits he used a beta-blocker to enhance his viola performance, and continues to happily play for the New York Philharmonic, enjoying enormous professional prestige. What accounts for this remarkable difference in treatment?

The Possibilities for Human Redesign

Using beta-blockers to reduce hand trembling is but the tip of the iceberg in efforts to improve upon human biology. Already today, people use steroids to increase strength, Ritalin to improve mental concentration, Prozac to increase happiness, plastic surgery to enhance looks, human growth hormone to increase height, and Viagra to increase their sexual prowess.

Increasingly, our efforts to redesign humans focus on changing our genes, or

[1] Lockwood, A. H. (1989). Medical problems of musicians. New England Journal of Medicine, 320, 221-227.

more typically the genes of our children. People advertise in the newspapers to buy sperm or eggs from donors who are tall, athletic, and have great SAT scores, hoping this will increase the odds that their children have those characteristics. They use genetic screening to select sperm and eggs pre-conception, the embryos they will implant, or the fetuses they will abort.

True, picking a sperm or egg donor is a relatively crude way to control characteristics, no more precise than picking the right mate, which has always been with us as a way to try to influence the genetic makeup of our offspring. Further, genetic screening is today largely limited to simple issues, like selecting the sex of the child or screening for single-gene diseases. But scientific developments are likely to give us far greater ability to identify genes associated with desired traits in the future, allowing people to increasingly fine tune the genes their offspring have.

Medical science also makes it increasingly possible to directly alter our genes to alter characteristics. Scientists have already genetically altered mice to create a "smart mouse" that enjoys greater mental ability and a "mighty mouse" that enjoys greater strength. The smart mouse gene alteration works by addition. Mice naturally have a gene called NR2B that makes a neuroreceptor called NMDA. What scientists did was to genetically alter mice to add second copy of this gene. These altered mice remembered more, learned faster, and were more able to solve maze tasks, leading scientists to call them Doogie mice, after Doogie Howser, M.D. "They're smarter," concluded Princeton Scientist Joe Tsien. Moreover, scientists altered this gene so its activity increased with age, offsetting the decline in the natural gene. The result was that older mice retained the brain plasticity of younger mice. A similar result was duplicated for rats. Although no study has yet duplicated this sort of enhancement result for humans, we do have the same NR2B gene that mice have.

The mighty mouse gene alteration works by subtraction. A naturally occurring gene produces myostatin, which keeps muscle development in check. By silencing this gene in mice, Johns Hopkins scientists were able to produce mice that were twice as strong as their siblings. Although deliberate efforts to alter this gene have not yet been tried in humans, in Germany a baby boy was born with muscles that were twice as large as normal. When the baby was examined, it turned out that both copies of his myostatin gene had a mutation that silenced the production of myostatin. The mother had the mutation in one of her two copies of the myostatin gene, and while not quite as musclebound as the baby with two mutations, had been a professional athlete and came from an unusually strong family.

Other genetic alterations work by increasing gene activity levels. Case-Western scientists have created "super mice" by injecting a highly active form of a gene for the enzyme PEPCK-C into a mouse embryo. These super mice can run without stopping for six hours, covering four miles. The super mice also ate 60 percent more than normal mice, but were fitter, trimmer, lived longer, and bred for three times more than the normal maximum age. Instead of being twice as big as normal mice, like the mighty mice, the super mice were half the weight and very aggressive. Although no one has apparently attempted to duplicate such results in humans, Case-Western Professor Richard Hanson observed that, "We humans have exactly the same gene."

Social behavior can also be genetically altered. While prairie voles are naturally monogamous, meadow voles are naturally promiscuous. Emory scientist Larry Young has shown that introducing a prairie vole gene for vasopressin receptors into the brains of meadow voles can make the latter more monogamous. Introducing the same gene into promiscuous mice does not quite make them monogamous, but does make male mice more affectionate with females. As this study indicates, genetic changes can cause important changes even when they are made to the existing cells of adult mammals rather than to the germ cells that are passed on to the next generation. The application to humans is uncertain, but, intriguingly, Swedish scientists at the Karolinska Institute have found that having multiple copies of a section of the vasopressin receptor gene in humans made heterosexual men more likely to be unmarried or, if married, have marital crises. Another study found that people with autism often have multiple copies of the same gene section.

None of these dramatic studies mean the same sort of genetic alterations would work on humans, who are presumably more complicated than mice and voles. But one should not exaggerate the differences in basic biology. Humans share 98% of their DNA with mice. In all the above studies, humans have the same or parallel gene as the one altered in mice or voles. The German case suggests that silencing the myostatin gene is likely to have similar muscle-increasing effects on humans, and the Swedish study suggests that varying the vasopressin receptor gene may well have similar social effects on humans.

Some are approaching human redesign from the opposite direction. Rather than enhancing human biology, they are creating machines that can replace human anatomy with greater functionality. Artificial limbs have already developed to the point that Oscar Pistorius, a double-amputee below his knees, was disqualified from the 2008 Olympics on the grounds that his artificial "Cheetah flex" feet gave him an unfair advantage because they enabled him to run with 25% less energy

than runners with normal feet.[2] Neuroelectronic interfaces have been developed that allow the human brain to directly communicate with mechanical parts using electronic signals, permitting the human brain to control and/or experience input from artificial limbs, ears, and eyes. Although in early development, and so far designed to replace only normal functionality, neuroelectronic interfaces could in the future allow us to endow humans with mechanical parts that give them to have better strength, speed, eyesight, or hearing than any human. The Six Million Dollar Man from the old television show may in the future no longer be a matter of science fiction, and some may opt to replace their all-too-human parts with better and stronger mechanical ones.

Experiments by Professor Kevin Warwick have even demonstrated the ability to give humans new senses, different from any current human sense. In one experiment, he connected an ultrasonic sensor to his nervous system. His brain was able to interpret the input from this sonar sensor well enough allow him to navigate a room blindfolded, giving new meaning to being Batman. In another experiment, he was able to give himself and his wife an ability to communicate telepathically, by linking their nervous systems electronically, so that he experienced neural impulses when she moved her hand. Such connections might in the future allow direct brain to brain communication through neural impulses, without going through the ordinary mechanisms of translating our thoughts into sights and sounds that others can experience.

Some envision the day when an entire robot body can be controlled and experienced by a human brain, perhaps situated in the robot body itself, or maybe more likely one in a human body that communicates wirelessly with its mechanical avatar. Indeed, there is no reason why the controlled machinery has to resemble a human body at all. Professor Warwick has already used neuroelectronic interfaces to directly control a computer with his neural impluses, having the neurally-controlled computer turn on lights, drive a wheelchair, and (through the Internet) control a machine across the Atlantic ocean. In the far future, one could imagine neuroelectronic interfaces allowing a single human brain to directly control a fleet of planes, ships or tanks.

The human brain might itself be supplemented by interfaces with computer

[2] This decision was later overturned by the Court of Arbitration for Sport on the ground that insufficient evidence was established that the artificial feet gave Oscar Pistorius an overall advantage. He barely missed qualifying for the 2008 Olympics, perhaps in part because he was mainly occupied by litigating rather than training during a crucial period, but planned to train hard for the 2012 Olympics.

chips that give the brain direct access to greater computational power than the human brain now allows. As Professor Warwick explains, "Artificial intelligence can think much faster than we can, it has phenomenal mathematical capabilities and can understand the world in many dimensions. But as humans we are limited to three dimensions, we think pretty slowly in comparison with how a computer can operate. Having this advantage of technology why not enhance, why not upgrade what we are and how we do things by linking myself to that technology, why can't I have extra memory? . . . Let's not just think of therapy. The human brain is not the ultimate! This is a starting point and we can take it further by linking up with technology!"

Developments in artificial intelligence suggest that in the future we will even be able to create robots that, without any component of human biology, have self-consciousness and an ability to reason and make autonomous decisions that is comparable to humans. To be sure, that future may be far off. Professor Warwick observes, "Our robots have roughly the equivalent of 50 to 100 brain cells. That means they are about as intelligent as a slug or snail or a Manchester United supporter." But already Professor Warwick has been able to develop a robot that was able to use artificial intelligence to not only learn how to move itself, but then to teach, via the Internet, another robot how to move. The second robot was thus not taught or programmed by a human, but instead was taught by another robot based on its own learning experience. The robots with artificial intelligence also exhibited unanticipated behavior, including one robot who committed suicide when it could not cope with its environment. So while it may take a while, it seems quite possible that in the future we will be able to create robots who have the same intellectual characteristics that philosophers use to explain why humans are entitled to be treated differently than animals or plants. At that point, the category of human will no longer be coextensive with personhood, and the possibilities for redefining the abilities of persons will be limited only by the machinery we (or perhaps they) can build. We will have reached the ultimate extreme of human redesign – creating persons who have no human components at all.

Current Regulatory Limits

Although the technical possibilities for human redesign are fairly dramatic, such enhancement efforts remain relatively peripheral today, with widespread usage limited largely to exploiting the possible enhancement effects of drugs or devices that were (like beta-blockers) initially developed to treat disease or

disability. Why is that? Part of the reason is surely that there are health risks and technical complications that raise serious concerns and obstacles. But the biggest reason is that such interventions are generally prohibited, either legally or through strong institutional controls. The Food and Drug Administration (FDA) has to approve new drugs and devices as "safe and effective," and generally (though perhaps mistakenly) does so only to the extent they treat a disease or disability, rather than seeking to enhance a normal human trait. True, once the FDA has approved a drug or device, physicians can use them for an enhancing purpose, called "off-label" usage because it varies from the FDA-approved label. Indeed, enhancing medical interventions almost always involve the use of drugs, devices, or techniques that were all originally developed for the treatment of diseases or disabilities. However, medical ethics are commonly understood to make it improper to prescribe drugs or do procedures unless they treat a disease or disability. This understanding may also be mistaken, but the limitation of regular medical practice to actions that treat disease or disability has been a central organizing principle of medical regulation, whether that regulation is legal or through professional self-regulation.

Many doctors may disagree with this ethical conclusion. But they will not have access to enhancing drugs or devices that do not have a treatment effect because such drugs or devices will not be developed without FDA approval. Their enhancement tools will thus be limited to the drugs or devices that happen to also have a treatment effect, which is doubtless only a subset of the enhancing drugs and devices that could be developed in a different regime. Moreover, even if they are willing to use drugs or devices for enhancing purposes, they may be deterred by the lack of good data on those enhancing effects, which itself is a product both of the government's refusal to fund research or clinical trials on enhancing interventions and of rules that some argue make it illegal or unethical to conduct clinical trials on possibly enhancing interventions.[3]

Deprived of data or common clinical practice supporting enhancement interventions, doctors might incur considerable risk of malpractice liability by openly engaging in enhancing interventions. Instead, the common tendency is to increasingly classify more and more human conditions as a disease or disability in order to justify the interventions under prevailing medical principles. Or, as in the case of Kenneth Mirkin, to borrow a drug from a friend or family member who got a prescription because they have a more traditional disease or disability. But both of these sorts of enhancement efforts are discouraged by uncertainties about the likelihood and magnitude of enhancing effects, compounded in the latter case by a

[3] R. Dresser, "Designing Babies: Human Research Issues," *IRB* 26, no. 5 (2004): 1-8.

lack of medical advice about dosage and adverse side effects.

Limits on genetically altering humans are even stronger. Not only have gene transfer techniques been limited to efforts to cure disease or disability, they have also be limited to correcting ordinary somatic cells rather than the germ-line cells that we pass on to our heirs. The European Union has interpreted its Convention on Human Rights and Biomedicine to prohibit any inheritable genetic modifications out of a fear that "misuse of these developments may endanger not only the individual but the species itself."[4] Some scholars advocate a new UN Convention that would internationally prohibit all research into cloning and inheritable genetic modification on the ground that altering the human species is a crime against humanity.[5] Even without such an international treaty, government practice denies research funding into work involving alterations to human genes.

These regulatory limits are well understood by scientists, including those directly engaged in genetic modification research. Typical is the reaction of Case-Western Professor Richard Hanson, the creator of the super mouse gene who, after acknowledging that humans have exactly the same gene, went on to say. "But this is not something that you'd do to a human. It's completely wrong. We do not think that this mouse model is an appropriate model for human gene therapy. It is currently not possible to introduce genes into the skeletal muscles of humans and it would not be ethical to even try." While thus flatly ruling human genetic alteration out of bounds for any purpose, he thought the findings could properly be used to develop drugs that enhance muscle performance, as long as they were used only to treat disease or disability. "It's very possible. It's a different approach to putting a gene into a human. I would only do that to help anyone who suffers from disorders such as cystic fibrosis." Thus, consistent with conventional medical limits, he was unwilling to consider making a similar genetic alteration to humans with cystic fibrosis, even though that might provide a better cure for their affliction. Nor would he consider developing a drug or genetic alternation that might help make normal humans have longer lives that were fitter and trimmer.

Likewise, the other scientists who have done gene alteration work assume that the only way to extend their work to humans would be to help develop drugs to treat disease or disability. The scientists who created mighty mice by silencing

[4] Convention For The Protection Of Human Rights And Dignity Of The Human Being With Regard To The Application Of Biology And Medicine: Convention On Human Rights And Biomedicine, Oviedo, 4.IV.1997.

[5] George Annas, Lori Andrews, and Roasrio Isasi, "Protecting the endangered human: toward an international treaty prohibiting cloning and inheritable alterations," *American J. Law & Medicine* 28 (2002); 151-78.

their myostatin gene are working with drug companies to research whether they can create a drug that inhibits myostatin production to treat human diseases like muscular dystrophy or the muscle-wasting in patients with cancer or AIDs. They are not considering whether silencing the myostatin gene in those same patients might produce a better cure with less side effects, nor whether they could develop a drug that might make normal humans stronger. The scientists who created the Doogie mice suggested that the possible extension to humans would involve treating mental disorders with drugs that would boost the effects of the neuroreceptor gene. Likewise, the scientists who genetically altered meadow voles to make them monogamous and mice to make them affectionate were using the work to see whether they could treat autism with drugs that target the vasopressin receptors affected by the relevant gene. Off the table for everyone were genetic alterations, even to cure disorders, or developing drugs to enhance these attributes in normal humans.

Oddly, we probably impose the least regulatory restrictions on efforts to replace humans, in part or whole, with machines. In part this is because most of these efforts are directed at helping persons who have clear disabilities, which makes these efforts fit comfortably within the conventional medical treatment paradigm. But once one is creating machinery to replace human parts, there is no real limit on research to make those machinery parts as powerful as possible. Neuroelectronic interfaces offer especially strong enhancement potential because, once developed to allow the brain to control and experience mechanical parts that correct disabilities, they can readily be extended to control and experience all sorts of other machinery. Moreover, the most radical form of human redesign – the use of artificial intelligence and robotics to create new beings whom can function like humans without have any human component at all – is largely unregulated, precisely because it requires no experimentation or action on humans at all, and thus falls outside the bounds of medical regulation entirely.

The Coming Death of the Medical Treatment Limit

Thus, as dramatic as developments in our ability to enhance the biology of humans have been, these developments – and the extent to which they are widely used – have been constrained by the medical treatment limitation, which generally limits interventions on humans to curing disease and disability, and allows such cures only through nongenetic alterations. Perhaps the best defense for this limitation is that it tracks a sensible risk-benefit calculation. As put by distinguished Harvard philosopher Norman Daniels, if we are trying to cure a

disease or disability, the benefits are large enough to offset the medical risks, but "if we are trying to improve on an otherwise normal trait, the risks of a bad outcome, even if small, outweigh the acceptable outcome of normality."[6]

At first blush, this seems like a sensible prudential rule, but to really understand its implications, we need to understood what concretely distinguishes being normal from having a disease or disability. A disease or disability is typically defined, in work that Daniels himself helped pioneer, as: "Any state of a person's biology or psychology which reduces species-typical functioning below some statistically defined level."[7] In short, a disease or disability is something that puts our functioning in a sufficiently low percentile to bring our functioning below the normal statistical range. Just what determines that percentile depends on judgments about the importance of the characteristic for functioning in society. For intelligence, having an IQ in the bottom 2.5% (below 70) is defined as a disability,[8] whereas for height it is the bottom 1.2%, which the FDA ruled was when human growth hormone could be used to correct short stature that did not have an understood cause.[9] Thus, the prudential judgment of the medical treatment limit is that if your characteristic is below a certain percentile in human functioning, then the benefits of addressing the problem are worth the risk of biological intervention, but if above that percentile, the risks exceed the benefits.

However, there is no real reason to think that the risk-reward tradeoff for every biological intervention magically gives us a line that happens to equal the bottom of the normal range for the condition of interest. It all depends on the particular risks and benefits of the specific intervention. There may be many characteristics above the bottom of a normal statistical range that are worth correcting because the benefits are large relative to the risks. True, one could account for this issue by simply raising the percentile threshold until it matched the relevant risk-benefit tradeoff. We seem to have already done so for interventions to correct eye-sight, allowing such interventions when eyesight is below 20/20, even though only 35% of adults have 20/20 vision without correction.[10] Allowing

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[6] Norman Daniels, "Can Anyone Really Be Talking About Ethically Modifying Human Nature?," in *Human Enhancement* 25, 38 (eds. Julian Savulescu & Nick Bostrom, Oxford University Press, paperback 2010).

[7] Julian Savulescu et al., "Well-Being and Enhancement" in *Enhancing Human Capacities* 3, (eds. Julian Savulescu et al., Wiley-Blackwell 2011).

[8] *Id.*

[9] Kaufman, "FDA Approves Wider Use of Growth Hormone," Washington Post at A 12 (July 26, 2003).

[10] Mehlman & Berg, "Human Subjects Protections in Biomedical Enhancement Research: Assessing Risk and Benefit and Obtaining Informed Consent," 36 *J.L. Med. & Ethics*

such interventions thus effectively defines the bottom 65 percentiles as "below normal." But once we take this step, it seems clear that the line has less to do with any statistical assessment of normality than with a sensible judgment that the risks of eyesight correction are relatively low compared to the benefits for everyone in the first 65 percentiles. If the normality line simply tracks such risk-benefit tradeoffs, then the medical treatment limit becomes meaningless, amounting to nothing more than an admonishment to act only when the benefits exceed the risks, which presumably anyone considering an enhancement would want to do without any regulatory limit.

The line provided by the medical treatment limit becomes even fuzzier when the disease or disability is defined in terms of conditions rather than percentiles. Consider the use of Ritalin and other drugs to treat attention deficit disorders. The American Psychiatric Association stated in its 2000 diagnostic manual that 3-7% of school-aged children have attention deficit disorders, which is a relatively high percentage given ordinary standards of normality. The percentage of children aged 6-17 diagnosed with attention deficit rose from 6% to 8% from 1997 to 2006, reaching 10% for children aged 12-17, and 12% for all boys aged 6-17.[11] From 2003-07, the percentage of children aged 4-17 who had ever been diagnosed with an attention deficit disorder rose from 7.8% to 9.5%, with the rate reaching 13.2% for boys.[12] The diagnosis of attention deficit disorders has also been increasing in many other nations.

Similar issues have been raised about the use of Prozac or other antidepressants to treat depression and other mental disorders. From 1996 to 2005, the percentage of non-institutionalized U.S. persons aged 6 or older who were on an antidepressant prescription rose from 6% to 10%, meaning 27 million were receiving antidepressants by 2005.[13] The 2005 rate was 12% for whites, 13% for women, 17% for those who were divorced or widowed, and 22% for the unemployed. The number of total antidepressant prescriptions increased by 17% from 2005 to 2009, while the US population increased by 5%, so the 2005 percentages are probably all about 12% higher today.[14] Elsewhere in the world,

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546 (2008).

[11] CDC, Diagnosed Attention Deficit Hyperactivity Disorder and Learning Disability: United States, 2004–2006.

[12] CDC, Increasing Prevalence of Parent-Reported Attention-Deficit/Hyperactivity Disorder Among Children --- United States, 2003 and 2007.

[13] Olfson, et al., "National Patterns in Antidepressant Medication Treatment," Archives of General Psychiatry, Vol, 66 (No. 8), 848-.

[14] IMS Health, Top Therapeutic Classes by U.S. Dispensed Prescriptions (updated April 6, 2010).

there has been a similar explosion in the prescription of antidepressants.

Many complain that this high and increased rate of diagnosing depression and attention deficit disorders reflects an unfortunate cultural tendency to over-medicalize ordinary human life. But perhaps the underlying cause is that the medical treatment limit *requires* calling something a disease or disability in order to get the medical intervention. After all, the rapid increase in diagnosis of depression and attention deficit disorders has occurred across varied cultures and coincides with the advent of drugs that could increase happiness or mental concentration. Perhaps the underlying phenomenon is thus that these drugs are believed to provide mood or cognitive benefits that exceed the health risks for a substantial segment of the population, and doctors are willing to slowly adjust notions of disease or disability in order to be able to prescribe these drugs to patients who would receive net benefits from them. If so, the problem of over-medicalization may be less cultural than legal: that the law requires diagnosing patients with a disease or disability in order to given them a drug that makes them better off. In the short run, this may have the unfortunate effects of requiring physicians to misdescribe medical conditions and patients to feel bad or stigmatized for having a disease or disability. In the long run, it suggests that the medical treatment limit has a hard time holding in the face of perceptions that a broader range of persons can benefit from a medical intervention. Already, for example, research suggesting that interventions might slow or eliminate the aging process has led some to proclaim that aging itself is a disease.[15]

Perhaps the treatment limit at least provides a crude rule that generally indicates when the benefits of biological intervention are likely to outweigh the health risks, even though that general presumption might be rebutted for particular interventions. But even at this crude level, such a tradeoff is necessarily dependent on the particular technological circumstances that determine the rewards and risks. Even if the crude tradeoff justified a medical treatment limit in the past, there is no reason to think it does so now or will continue to do so in the future. As the science advances, a new set of biological interventions will likely arise that inflicts less risk, or confers greater benefits on those in the normal range, which ultimately will change the crude risk-reward tradeoff.

In the future, I suspect we will look back on medicine having had three ages. The First Age of Medicine, which ended only in the early 1900s, was when medicine was so poorly developed that it was on average more likely to harm than

[15] [cite]

help.[16] The Second Age, the century from the early 1900s to early 2000s, was when scientific advances meant medicine could help more than hurt, but generally only if it were confined (via the treatment limit) to cases where people suffered such egregious problems that there were very large benefits to set against the risks. In the coming century, we are likely to reach the Third Age, when medical progress will reach the point that medicine can often confer benefits on those without any disease or disability that are large enough to offset the health risk. We are currently in the transition from the second to third of the Three Ages of Medicine, which at some point will result in the breakdown of the treatment-enhancement line and the open use of medical interventions to enhance normal attributes.

Indeed, there are a few areas where that is arguably already the case. Although acne is medically called a disease, that characterization seems strained for a condition that affects almost all children during puberty, and culturally no one feels it is necessary to conclude that their pimples have reached a state of disease or disability in order to justify a trip to the dermatologist. Likewise, while various forms of plastic surgery were originally developed in order to treat injuries or diseases, today they are widely used to achieve cosmetic benefits without legal prohibition. The plastic surgeon and patient may be more likely to go ahead with a nose job if it can also fix a deviated septum, but many are perfectly willing to go ahead if the nose is simply larger than desired. Here, even when the benefits are only cosmetic, the risks are low enough that we seem to have no problem allowing biological interventions without requiring a real disease or disability. If we are willing to lift the medical treatment limit to achieve cosmetic benefits when the risks are low, it seems unlikely we would be unwilling to do it if low risk methods arise to increase mental ability or other desirable attributes.

Even if, despite these changing risk-benefit tradeoffs, we could hold the line on treating only the bottom percentiles, the medical treatment limit would fail to provide any long run constraint on biological interventions. After all, if we keep allowing any biological intervention that eliminates conditions that are in the bottom 1-2% of the then-current range, we will keep moving people out of that bottom 1-2%, which will just create a new set of people in the bottom 1-2% to treat. Once we treat them, there will be another new set of people to treat, and so on. In the fictional land of Lake Wobegon, it might be possible for everyone to be above average, but in the real world that is not possible. Likewise, we cannot live in a fantasy land where no one is in the bottom percentiles. The medical treatment limit will thus be an inevitable victim of medical progress, which will keep

[16] [cite].

chipping away at the bottom percentiles and shifting the distribution of attributes higher and higher. In the long run, then, full success in medical treatment converges on allowing all biological enhancements.

Thus, the medical treatment limit cannot set any meaningful long-term constraint on efforts to remold human biology; it can only slow them down. If there is something truly wrong with some of those efforts, the medical treatment limit fails to stop them from eventually becoming pervasive. If there isn't anything truly wrong with those efforts, then there is no good reason to slow down their adoption.

Another reason the medical treatment limit is ultimately unsustainable is that scientific developments are likely to increasingly result in treatments that are also enhancing, which will further blur the enhancement-treatment line. This is already the case to some extent. Lasik surgery may leave a nearsighted person with 20-15 vision. A nose job to fix a deviated septum may leave a big-nosed person with a nose more lovely than average. Beta-blockers themselves can be both treatment and enhancement when they are used by a shooter or musician with heart problems. Thus, even if otherwise effective, a medical treatment limit might merely funnel enhancement research into treatments that also enhance.

Treatment-enhancement overlaps are likely to be increasingly raised by better interventions, especially mechanical interventions. While biological treatments typically cannot leave the patient any better off than somewhere in the normal range, mechanical interventions have the potential to fix a disease or disability while leaving the patient more able than anyone that normal range. If disability-corrected persons are more able than normal persons, it seems unlikely we would deny the same correction to normal persons, especially because efforts to do so raise the strong possibility that people might deliberately disable themselves to get the enhancement. For example, suppose Oscar Pistorius wins the 2012 Olympics because his artificial Cheetah-Flex feet actually do confer a competitive advantage. One could well imagine someone with dreams of Olympic glory having his own feet amputated so he could get Cheetah-Flex feet too. (After all, some people amputate their own limbs just because the limbs make them uncomfortable, and here the motivation would be even stronger.) For reasons discussed below, I suspect this problem would ultimately be resolved by prohibiting the use of Cheetah-Flex feet in sports competition. But the issue will not be so easy to avoid when the mechanical enhancement is used to achieve a real improvement that does not depend on the rules a sport lays down.

Even if the medical treatment limit were sustainable, it would be deeply

problematic because it assumes a status quo baseline (the normal range), without any persuasive explanation for why we should deem the status quo to be so desirable that it should prevent us from enjoying improvements above that baseline. Such a status quo baseline is, after all, historically contingent. People used to have much worse teeth, so that in the Medieval Age someone with cavities might well have been regarded as within the normal range, given how many rotten teeth others had. Presumably we don't think this means dental care today should not treat cavities. Nor do I detect much yearning for the old status quo of shorter lives and heights, so it isn't clear why we should object to a future of longer lives and taller heights.

A sustainable medical treatment limit would also draw many dubious distinctions because it draws the status quo baseline at such a low level. For example, given the definition of disability, the medical treatment would mean that an intelligence-enhancing drug that improved someone's IQ from 69 to 70 would be permissible because an IQ of 69 is below the normal range and thus qualifies as a disability. Indeed, the government would be obligated to fund use of that drug in any system that offers universal health care. However, using an intelligence-enhancing drug to improve an IQ from 70 to 100 would be affirmatively prohibited under the medical treatment limit, even if the health risk is low and the person pays for the drug himself, because the person started within the normal range of intelligence. It is hard to see what would justify that sort of distinction.

The medical treatment limit is also deeply ambiguous because it provides no theory to explain which set of persons we should use to define the relevant normal range. To begin with, should the normal range be based on the set of persons with one's own sex or ethnicity? Consider the FDA rule that allows the use of human growth hormone only for children who are in the bottom 1.2% of height. This rule actually defines a separate bottom 1.2% for boys and girls – boys are eligible if without the hormone they would be shorter than 5'3", girls if they would be below 4'11". Thus, the fact that a girl who would grow to 5'0" means she is denied access to a medicine even though the same predicted height would entitle a boy to it. This embraces an implicit normative claim favoring a height differential between men and women. The controversial nature of this normative claim can be seen by asking: would we do the same for different ethnic groups? Suppose it is the case that the bottom 1.2% is 5'1" for Latino men.[17] Would we say Latino men who would grow to 5'2" should be denied growth hormone, while non-Latino men who

[17] The 5th percentile for Latino men is 5'3" compared to 5'6" for Whites and 5'5" for Blacks according to http://www.halls.md/chart/height-weight.htm.

would grow to that height get it? It is hard to imagine the FDA would engage in such discrimination against Latinos, but such a distinction is hard to distinguish from the discrimination that the FDA mandates against women. If instead we do not allow such discrimination, but rather draw the same height line across all sexes and ethnicities, then it will be the case that a higher proportion of women and Latinos will be eligible for human growth hormone than men and non-Latinos. One might then argue that the line discriminates against men and non-Latinos.

If we allowed distinctions based on ethnicity, then the logic would seem to require further problematic linedrawing based on nationality. Suppose, for example, we drew the Latino/non-Latino distinction described above. Would I be able to argue that, because I am of Argentinian descent and Argentinians are taller than the average Latino, the height line for my children should be higher? If so, then someone of Scandinavian descent should also be able to argue that, because they are taller than the average white person, they should get a higher height line. Actually, because I am 1/4th Danish, I could argue both.

Quite apart from distinctions based on nationality, a status quo baseline raises troubling questions about which nations to look to at all. The FDA defined its standard using the U.S. baseline, making the standard higher than it would be if the FDA had instead used a world baseline. But if a U.S. and foreign person would grow to the same short height, what is normatively attractive about saying the U.S. person should be free to use a human growth hormone denied to the foreigner? It is not clear whether we should define the baseline in terms of the average in the world, in one's own nation, in nations like one's own, or in developed nations.

One could raise similar problems based on family distinctions. For example, suppose Joe says that, although he is above the bottom 1% of U.S. males in height, he comes from a very tall family and is within the bottom 1% of his family, which makes him feel bad. Under a status quo baseline, he would seem free to argue that his normatively relevant status quo is his family, not his general ethnicity group. But if we did that, we would discriminating against persons who came from generally shorter families.

It is not even clear why any status quo baseline should be judged in terms of such in-born traits or national residence at all. For example, in the NBA being below 5'10" would put you in the bottom 1% of players even though it is the average height for U.S. men.[18] Suppose Sam is 5'9" and in the NBA. Should he be

[18] Two NBA players were less than 5"10" in 2004-05.

able to argue that he should get access to human growth hormone because he is in the bottom 1% of NBA players? After all, in terms of his life chances, this may be a far more relevant group than national or ethnic averages. This sort of logic suggests all of us should be able to define the groups that we regard as normatively relevant when establishing our status quo situation, but then any rule breaks down.

The underlying problem in all the above cases is the same. The lines are difficult to draw because, even if it were sustainable, the medical treatment limit provides no real theory defining what it is about the status quo that should be regarded as so normatively attractive that it mandates prohibiting change. If we had such an underlying theory, we could advert to it directly rather than relying on the status quo. To the extent we instead rely on a status quo that is defined independently of any normative theory, then there will be many possible ways of deciding which set of persons constitutes the relevant status quo, and we will not have a sufficient normative theory for determining which set is the right one to use.

Even if the medical treatment limit were generally valid and sustainable, it would provide no help in explaining our beta blocker puzzle. After all, the FDA does not approve the usage of beta blockers to enhance performance of classical music any more than it does for shooting or archery. True, the 1987 survey found that 19% of musicians taking beta-blockers did have a prescription for heart conditions.[19] But this is a small minority, and does not help with even 19% of the puzzle because the Olympics bans shooter and archers from using beta-blockers even if they have a prescription for heart conditions. Although the Olympics has a therapeutic use exemption, it applies only if the drug not only treats a significant health problem, but also produces no significant performance advantage.[20]

The same 1987 survey found that another 11% of musicians taking beta-blockers had a prescription for occasional music performances, typically justified as treating anxiety. Because the FDA has not approved beta blockers to treat anxiety, this is an example of physicians providing an off-label prescription. To be sure, off-label prescriptions for anxiety could in theory fit within a traditional treatment limit because severe anxiety can be a disease or disability. However, getting nervous before performing is fairly normal, and it seems unlikely that so many musicians suffer from an anxiety disorder severe enough to qualify as a disease or disability under ordinary medical standards. Moreover, the controlled

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See http://www.nba.com/news/survey_height_2004.html#bottom. Since each of thirty teams had 12 players, than means they were in the bottom 2 out of 360.

[19] Lockwood (1989).

[20] *See* [cite].

study showed that beta-blockers do more than calm anxiety during stressful performances: they improve performance technique in a way that musical judges find superior. Other studies show beta blockers are most effective when musicians are experiencing physical manifestations of anxiety (like tremors) and less effective when musicians are experiencing cognitive anxiety.[21] The practice of physicians giving off-label prescriptions for occasional use of beta-blockers by classical musicians is thus probably an example of how physicians adjust standards of disease or disability when the medical treatment limit would otherwise bar a desirable enhancing use.

In any event, even if we could fit this 11% of musician beta-blocker usage within the medical treatment limit, it would provide no help even with 11% of the puzzle. After all, shooters and archers get anxious too, and yet beta-blocker usage by them is banned even if a physician prescribes them beta-blockers to treat their performance anxiety. Further, the remaining 70% of musicians that used beta-blockers had no prescription for its use, so the vast bulk of musician usage cannot be justified under the medical treatment limit. True, one could conclude from this that the bulk of musician usage is actually condemned, just as it is for shooters and archers. But the usage by this 70% of musicians is the same as that by the 11% of musicians who do have a prescription for occasional use, and it seems odd to argue that the propriety of using beta-blockers to improve musical performance should turn on whether musicians happen to have access to physicians willing to write such a prescription. Moreover, any condemnation is surely half-hearted. We see none of the enforcement efforts against musician use of beta-blockers that we see against use of the same drug in the Olympics, nor do we see any of the criminal enforcement against drug use without a prescription that we see against, say, steroids. Thus, while musician use of beta-blockers without a prescription is technically illegal, the "law in action" is effectively permissive. Nor do we see the sort of widespread outrage that we see against many other uses of performance-enhancing drugs. Instead, beta-blocker use by classical musicians seems to enjoy wide social acceptance, notwithstanding some critics. For the majority of us who find beta-blocker use acceptable by classical musicians but not by shooters and archers, what explains the distinction?

[21] Dianna T. Kenny, "A Systematic Review of Treatments for Music Performance Anxiety," *Anxiety, Stress & Coping*, 18(3), Sept. 2005, pp. 183–208.

Other Dead Ends

The coming death of the medical treatment limit is going to require the development of a new distinction if we wish to cabin any efforts to redesign humans. There is no shortage of possible theories, most of which I will be debunking directly throughout the following chapters. But I began this chapter with the beta blocker puzzle because it cuts through so many of these objections and isolates the one objection that I think ultimately provides a defensible ground for limitation.

Excessive Health Risks. A common argument against human enhancement is that, even if in theory such enhancement could be permissible when the benefits outweigh the health risks, in practice the actual health risks are simply too great. However, this argument provides no help with the beta-blocker puzzle because precisely the same beta-blockers and health risks are at issue for classical musicians as for Olympic shooters and archers. Moreover, the reason that so many physicians are willing to prescribe beta-blockers to classical musicians is that the side-effects are minimal for the sort of occasional use involved in taking them for performances. As put by Dr. Michael Craig Miller, editor of The Harvard Medical Letter, “"There's very little downside except whatever number you do on yourself about taking the drugs.” The health risks might be greater without proper medical supervision, especially on dosage, but that concern suggests the permissibility of beta-blocker use should be made clearer, so that musicians are not reluctant to ask their doctor for beta-blockers.

Focusing solely on the health risks to users also mistakenly focuses on only part of the relevant effects. If individuals voluntarily seek to change their bodies, they must perceive some benefits to doing so. This theory thus raises the question of when those benefits exceed the health risks. Assuming they have received proper medical advice on what those risks are, one would think that the individuals who experience those benefits and risks would be as well placed to weigh them against each other as anyone. Thus, if the real concern were the health risks to users, the solution would seem to be making sure users get proper medical advice about those risks, and then letting patients decide for themselves whether they value the benefits more than those health risks.

More generally, to the extent the health risk argument actually has bite, it implicitly concedes that if the health risks to users were not too high, then the relevant human enhancement should be approved. This theory thus makes the disapproval of certain enhancing interventions contingent on the current state of technological development, for if our technological abilities evolved to lower the

health risks sufficiently, then this theory would make the intervention acceptable. Thus, like the treatment limit, this theory cannot provide any long-run constraint on efforts to redesign humans. Nor can it provide a plausible explanation for deep-seated objections to certain interventions that seem likely to persist no matter how much future technology lowers the health risks to users.

Unearned Benefits. Another prominent objection, made most eloquently by Professor Leon Kass, is that biological interventions to enhance the human body give us unearned benefits that amount to "cheating" and deprive our achievements of meaning. In contrast, improvements we earn, such as through exercise or practice, are fine. Again, this objection cannot explain the beta-blocker puzzle because any unearned performance advantage for Olympic shooters and archers is equally unearned when classical musicians use the same beta-blockers.

A more general problem with this line of argument is that many commonly condemned interventions, such as steroid use by athletes, actually require considerable effort to make them effective, because steroids generally make it easier to endure exercise and increase the muscle gains from it, but don't obviate the need for the exercise itself. Moreover, we actually do sometimes prohibit enhancement through excessive practice, such as in the college limits imposed on practice time. More generally, if earning our improvements is the important factor, it is not clear why it does not suffice that individuals worked to earn the money to buy their biological enhancements.

On the flip side, we generally praise medical interventions even if they require no patient effort. Indeed, we are likely to praise a treatment that requires no patient effort even more than one that does. I doubt, for example, that people would find it preferable if antibiotics required a serious workout in order to be effective. Further, many technological improvements have also given us unearned increases in abilities. Airplanes allow us to fly, computers allow us to see and access images and information throughout the world, and yet our usage of them is not condemned because we were not one of the Wright Brothers or because, unlike Al Gore, we did not help invent the Internet.

Perhaps the deeper problem is that people don't "earn" the natural abilities they were born with, so this distinction would seem to allow anyone who falls short of the very highest level of natural biological abilities to use biological interventions to bring them even with those who enjoy such an unearned advantage by birth. Nor is it at all clear why we should object to improving all our abilities without any effort – if we could make the IQ of everyone on earth 10 points higher through better nutrition, what would be the problem? The "cheating" objection is

circular, because it assumes the existence of a rule against the activity and thus cannot provide a reason for adopting or keeping that rule.

Creating Inequalities. A frequent objection to human enhancements is that they will exacerbate inequality because some will have more access than others to the enhancements. As with the objections above, this objection provides no help with the beta-blocker puzzle because there is no reason to think that access to beta-blockers would be any more unequal for Olympic shooters and archers than for classical musicians.

More generally, the inequality argument fails to justify a regulatory prohibition on human enhancements. To the extent the equality of interest is equality in using the enhancement, then the inequality objection would equally favor encouraging usage by everyone. Lifting the prohibition and subsidizing enhancements for those who cannot afford them is more likely to achieve equality than adopting prohibitions that will, inevitably, be imperfectly enforced.

To the extent that the equality of interest is equality in the human attribute that could be enhanced, then the inequality objection would affirmatively favor human enhancements for anyone who is below-average in that attribute. But if we allow human enhancements for any below-average attribute, we will necessarily be increasing the average more and more over time, allowing enhancements for more and more persons. Thus like the medical treatment limit, a below-average-trait limit cannot impose any long run constraint on human enhancements, and in fact will converge on allowing all biological enhancements even faster than the medical treatment limit would.

Another reason the equality objection cannot justify a prohibition on human enhancement is that such a prohibition entrenches the current inequalities that result from the genetic lottery. Equality grounds provide no reason to favor such "natural" inequalities.

Moreover, the equality objection offers no real reason to treat human enhancements differently than other efforts to improve ourselves. After all, people already spend great effort and sums of money to improve the capabilities of themselves or their kids by seeking better education, neighborhoods, piano lessons, sports training, computers, and so on. We do not seem to think that equity requires restraining everyone to educating themselves or their kids only until they are as educated as the average person and then stopping. Moreover, medical treatments are themselves delivered quite unequally, and no one argues that therefore they should be prohibited. The more cogent reaction to unequal distributions of

something that is desirable is to equalize the resources to buy it, rather than to prohibit it. As Professor Greely pointed out, the "single greatest current cognitive enhancing technology is primary education, particularly literacy and arithmetic," and not long ago it was available only to the rich. The solution was not to prohibit the rich from educating their children, but to provide free education to all children. Inequities still persist, but almost everyone would agree that the solution is to improve the free public education, not to worsen paid private education.

Thus, to the extent inequality is the relevant objection, we should focus on providing egalitarian access to human enhancements, rather than on banning them. Indeed, it seems to me that if in the future we can control our very genetic makeup through biological interventions, then that should increase egalitarian sentiment by undermining the current widespread sense that those born with better genes deserve their genetic advantage because it was conferred on them by God or nature. The more it becomes true in the future that the genes we have are the genes our parents could afford to buy for us, then the stronger will be the argument for redistribution to allow everyone an equal opportunity to buy good genes.[22]

Thus, the inequality objection suggests that, rather than prohibit human enhancements, we should tax any enhancements purchased by the rich in order to redistribute enough money to the poor that they could purchase equal levels of human enhancements. Doing so would redress the inequity of concern. Using a tax would also take into account the reality that, even with a more equitable distribution of resources, persons may not all want to use those resources on biological enhancements. Or even if they do, they might not choose the same enhancements. Some might prefer to be stronger than average, others to be smarter than average. Sensible notions of distributive justice should not preclude persons from choosing different features to improve.

Playing God or Nature. A more fundamental objection to human enhancements is that engaging in them exceeds the proper role for humans. In the religious version of this objection, we will be playing God. In the secular version, we will be interfering with nature and the wisdom of evolution. Indeed, human enhancement appears to be the one topic that unites evangelicals and evolutionists – with the former fearing interference with the work of God work and the latter interference with the work of evolution.

[22] *Cf.* Allen Buchanan, Dan Brock, Norman Daniels & Daniel Wikler, *From Chance to Choice: Genetics and Justice* 63-64 (Cambridge Univ. Press paperback 2001).

Neither the religious or secular version of this objection can, however, explain the beta-blocker puzzle. To the extent that calming hand tremors with beta-blockers is playing God or interfering with nature, it is equally so when done by classical musicians as by Olympic athletes. The ban on Olympian usage, but not musical usage, must thus rest on some other ground.

Moreover, while both objections are serious, neither in the end supports regulatory prohibition. From a religious perspective, most religions emphasize that God has bestowed humans with free will and "helps those who help themselves" by making affirmative efforts to improve their lot in life.[23] The quote I began this book with illustrates one important strain of religious belief, which is that God affirmatively gave man dominion over everything God had made, which would seem to freely allow any human efforts to modify themselves or other physical materials. Other theologians stress that man also has stewardship obligations, but those are generally thought to suggest implausible passivity, so that Christian "theologians have been moved to the metaphor of co-creation as a more adequate picture of the relation between God and man."[24] Likewise, Rabbi Dorff has stressed "We are God's 'partners in the ongoing act of Creation' when we improve the human lot in life," and at least one Islamic scholar describes humans "as participants in the act of creating with God."[25] There is thus at least some serious religious support across many religions for an important creative role for mankind.

To be sure, this leaves a lot of room for religious interpretation regarding which human efforts are properly within our co-creative role, especially because no religion assumes that role makes us equal with God. The attributes that religion ascribes to God can thus provide religious guidance as to proper limits on humans' subordinate, but creative, role. To those who believe in God, the grounds for the playing God objection are effectively that God is all-powerful, all-knowing, and all-good, whereas humans are sadly lacking on all three dimensions.[26] Those are real limits to human capacity that we should take into account; indeed, they are limits that should be taken seriously even by those who do not believe in God. But it turns out that none of these three limits suggests a good reason for generally prohibiting human enhancements.

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[23] C.A.J. Cody, "Playing God," in *Human Enhancement* 155 (eds. Julian Savulescu & Nick Bostrom, Oxford University Press, paperback 2010).

[24] *Id.* at 160.

[25] *Id.* at 160 n.6.

[26] *Id.* at 163.

The fact that we are not all-powerful seems, if anything, to cut the other way because it means there are limits to what we can do in changing humans. We may be able to make ourselves smarter, stronger, more attractive, and healthier, but (unlike the blue guy in the Watchmen) we are unlikely to be able to develop the ability to rearrange atoms at will with our thoughts. We will still be limited by physics, while God is not. We can thus take some comfort that, no matter how much we advance, we will always be, as the Bible says, "a little lower than God" – indeed, really a lot lower than God, given the gulf between what we can conceivably aspire to do and the awesome powers of God.

The fact that we are not all-knowing is certainly a ground for caution. However, it does not clearly cut in either direction because it makes us uncertain about the effects not only of our actions, but also of our inactions. Failing to engage in human enhancement will deny us the expected benefits of those enhancements. It may even result in catastrophic effects if, say, the lack of those enhancements means we lack the intellectual capacity to cure the next plague, steer away the next meteor, or repel an alien invasion. Nor are medical treatments any less subject to uncertainty problems. The best we can do is study our biological interventions as carefully as we can and engage in them only when, taking uncertainties into account, the expected benefits exceed the expected risks. If we fail to engage in interventions that meet this test, we will still be limited by our lack of omniscience, but now we will be making a decision that, given the uncertainties, makes our expected well-being lower.

The fact that we are not all-good is, alas, all too true. Proper regulation will have to take into account the fact that individuals have incentives to exercise the power to redesign humans in ways that may be harmful to others. This is the issue on which this book will focus throughout. However, this is not a factor at all unique to efforts to redesign humans. All regulation of human activity has to take into account the fact that human incentives may lead us to behave in harmful ways, and thus all regulation seeks to restrict such harmful conduct and reward and channel people towards more beneficial conduct. This is the ordinary stuff of regulation, though we shall see the issues play out here in rather unique ways.

The secular version of this argument argues that we should not interfere with nature. However, this seems an implausible account because traditional medicine involves "the comprehensive attempt to frustrate the course of nature."[27] Those using beta-blockers to reduce heart problems and high blood pressure are, for example, enhancing themselves relative to the natural rate of heart problems and

[27] John Harris, *The Value of Life* (London Routledge 1980).

high blood pressure that they would experience without medicine. Nature includes things like AIDS, cancer, floods, tornadoes, and storms. Being natural does not make something desirable.

The more pointed form of this objection stresses that evolution has already optimized mankind through the natural selection process. Efforts to change humans might improve one attribute, but evolution suggests that if improving that attribute would have improved our evolutionary fitness, we would have already evolved to have that enhanced attribute. The most usual reason we might not have done so is that there are tradeoffs between that attribute and other attributes. Millions of years of evolution have produced fine-tuned tradeoffs that optimized our overall evolutionary fitness, so that altering one attribute may upset a delicate balance. This makes it difficult to improve on the human body.

This is an important caution to take into account in trying to assess the odds that human enhancements will actually confer a net benefit.[28] However, what evolution optimized us for was the past, not the present. We may be evolutionarily well-adapted to the caveman days, but there is no particular reason to think we are evolutionarily well-adapted to the world that modern technology surrounds us with today. Consider the following human reaction. You are walking across the street, and suddenly you are surprised to see a car hurtling toward you. What is our natural instinct? To freeze in place. This is the worst thing we can do. We'd be better off speeding up, or at least maintaining our pace, to get off the road. But freezing in place when we see dangerous things bearing down on us was probably a great adaptation in the days when those dangerous things were likely to be wild animals. Then running would just attract chase, and we could not outrun the animals. Our best hope was to freeze in place, hoping to be unnoticed or thought dead, perhaps intimidating the animal with our seeming courage, and if all else fails, fighting face to face rather than being chased from behind. Freezing in place isn't our best hope now with the car about to hit us, but adapted to history, we continue to freeze in place long past the utility of this instinct.

More important, evolution optimized us for was a time when food was scarce. As a result, many otherwise beneficial human attributes may have been evolutionarily disfavored because they expended too much metabolic energy. [29] Now that we live in a time of abundance in food, those tradeoffs may have

[28] For a particularly thoughtful effort to do so, see Nick Bostrom & Anders Sandberg, "The Wisdom of Nature: An Evolutionary Heuristic for Human Enhancement," in *Human Enhancement* 375.

[29] *Id.* at 382-87, 390-91.

changed. For examples, our brains are 2% of our mass but take up 20% of our total energy consumption. In a time of food abundance, it may be more optimal to have larger brains that consume even more energy. Or consider our immune system. It can save our lives, but also takes considerable energy to run. Thus, the level of immune activity that made sense in a time of food scarcity may be much lower than the level that makes sense now, which may be why modern immunizations have been able to improve on evolution by increasing immune activity levels in ways that improve survivability. Finally, consider our appetites and desires for sweets. Those were probably quite adaptive to a time of food scarcity, when we needed to fatten up whenever food was available, especially on high energy food like sweets. But these appetites and tastes are, alas, quite poorly adaptive to a time and place when obesity is a much larger health problem than starvation.

Evolution also optimized us for a time when intellectual abilities were comparatively less important.[30] Certainly an ability to read was not evolutionarily important because for most of our evolutionary history we were illiterate. Dyslexia thus may not have been evolutionarily disadvantaged, and may indeed have had some advantages because it seems linked to enhanced visuospatial abilities that may have been more important to hunters. More generally, the modern world makes it much more important than in evolutionary days to be able to concentrate on abstract topics without being distracted by our surroundings. In our evolutionary past, this sort of ability might have been a liability, because someone who fails to keep part of the brain constantly monitoring their surroundings may have been more likely to be killed by predators or enemies. The distractedness that marks many attention deficit disorders, especially in young men, may thus have been evolutionarily adaptive, yet also be something that we can beneficially correct with modern medicine to cope with our different needs today.

We might also have different goals than evolution.[31] Evolution optimizes our ability to reproduce and pass on our genes. But our goals may differ from those. Most directly, we have developed a most unnatural control over our reproductive processes through contraceptives, which directly thwarts the evolutionary imperative. Presumably, we prefer the control this gives us over our family sizes. Perhaps more important, it seems likely that "evolution has not optimized us for happiness."[32] Rather, it puts us on a "hedonic treadmill" where we quickly adapt to our successes and seek more, and it fills us with feelings like

[30] *Id.* at 388-390.
[31] *Id.* at 392-97.
[32] *Id.* at 395.

jealousy, envy, anxiety, and dissatisfaction. These sorts of emotions may have made it evolutionarily more likely that we would pass on genes than the next guy. But now that the human race is far from any threat of extinction, it may be more beneficial to reduce human suffering through enhancements that increase our hedonic set-point or dampen our negative emotions.

Evolution also has certain technological limits.[33] For one thing, DNA can only code proteins. To the extent that desirable human enhancements involve mechanical alterations using other materials, they would not be available to evolution. Evolution can also get stuck in suboptimal spots if a small change would make us worse off but a big change would make us better off, because evolutionary generally involves incremental changes. Some think this is why we still have an appendix even though its main effect now is to increase the risk of appendicitis. The problem is that although a massive change, eliminating the appendix, would reduce this risk, making the appendix a little smaller actually increases the risk of appendicitis. Finally, evolution can simply take too long in a world where environmental conditions are changing rapidly.

Some argue that these considerations mean we should presumptively disfavor human enhancements unless we can show that one of the above grounds for deviating from evolution can be established.[34] However, there is a sense in which evolution cuts the other way, for while past evolution may suggest higher odds that certain changes to humans will prove mistaken, future evolution is likely to save us from the proliferation of enhancements that actually prove to be mistakes. Assuming any biological interventions are individually chosen, they are likely to affect only small numbers of persons directly. Such interventions will thus only have serious population effects if they spread. If they work out badly, others are unlikely to want to copy them. If the interventions do not affect our germ lines, they will not be passed on to our heirs at all, and we can thus stop them as soon as we realize they are mistaken. If they are passed on to our germ lines and spread, then we have good evidence that natural selection favors the characteristic. Unless the intervention confers a selective advantage, it will not stick evolutionarily. So it is unlikely that a decentralized process of voluntarily-chosen biological interventions would lead to any undesirable change to human nature.[35]

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[33] *Id.* at 398-405.

[34] *Id.* at 406-07.

[35] As Norman Daniels has rightly emphasized, any claim about human nature necessarily involves a claim about traits across a widespread population, so that changing a few humans

More modestly, human enhancements seem much less likely to raise cautionary concerns than the sorts of technological developments that could create mass environmental effects, such as pollution or radiation, which could affect an entire population. Thus, while we should certainly be cautious about any major change we make, human enhancements do not raise especially high levels of cautionary concerns compared to other technological changes.

Worsening Our Character. Another set of objections argues that human enhancement will worsen our character. Michael Sandel has evocatively argued that human enhancement will lessen our "openness to the unbidden" in a way that undermines our unconditional love for our children and "banish our appreciation of life as a gift" in a way that lessens our social solidarity with others.[36] Jurgen Habermas worries that genetic selection will harm children because they will no longer be "the sole author of their own life history."[37] Others worry that human enhancement will lessen the authenticity of our experiences because "we will be separated from who we really are and from how the world really is."[38] More generally, some have the Brave New World objection that allowing human enhancements will lead us to become shallow beings who live for nothing other than happiness stimuli we can automatically generate.[39]

Once again, none of these objections provides any help in assessing the beta-blocker puzzle. Adult use of beta-blockers does not raise the objections of Sandel and Habermas at all. To the extent that using beta-blockers to improve our performance makes us less authentic or shallower, those objections would apply equally to usage by Olympic athletes and classical musicians, and thus cannot explain the distinction in treatment. Nor do these sorts of objections seem that applicable to either of the cases at hand. One could easily conclude the opposite, that reducing hand trembling lets the authentic person perform free of that hindrance, and that they are using beta blockers not to achieve shallow goals, but rather to strive for an inspiring excellence in technical skill or music that they could not otherwise achieve.

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cannot change human nature. *See* Daniels, "Can Anyone Really Be Talking About Ethically Modifying Human Nature?", *supra* note .

[36] *See* Michael J. Sandel, *The Case Against Perfection* 96 (The Belknap Press of Harvard University Press 2007).

[37] Jurgen Habermas, *The Future of Human Nature* 79 (Cambridge: Polity 2003).

[38] Erik Parens, "Toward a More Fruitful Debate About Enhancement," in *Human Enhancement* 181, 184, *supra* note ; Kass, [cite].

[39] Fukuyama, Francis, *Our Post-Human Future* (New York: Ferrar, Straus & Giroux 2002); Leon Kass [cite].

Nor do I think that any of these objections proves telling more generally. I already discussed above why I think greater control over our genetic makeup should increase social solidarity rather than reduce it. Likewise, despite Sandel's argument in *The Case Against Perfection*, I see no reason why influencing the genetic makeup of our children would lessen either our openness to the unbidden or our unconditional love for them. The truth is that no matter how many genetic choices we try to control, there will always still be lots of random variation in other genetic factors and in the way those genetic factors interact with the environment. Sandel's argument thus seems to overestimate both the plausible degree of genetic control we will have and the extent to which those genes dictate what a person is. If the concern is perfection in parent control, then I have to agree with Salvador Dali's remark: "Have no fear of perfection – you'll never reach it." Nor do I see any evidence that parents who try to mold their children have less unconditional love for them. We already try to mold our children with immunizations, education, nutrition, and medical care, and that does not seem to alter unconditional love. As Sandel himself acknowledges, good parents combine unconditional love with transformative love. It seems perfectly plausible that we could both try to help our children become the best they can be, but love our children however those efforts work out. Finally, adoptive parents often pick the precise kid they will adopt, taking less risk than any genetic manipulator could, and I am unaware of any evidence that adoptive parents exhibit less unconditional love than other parents.

The Habermas argument seems to likewise overstate the extent to which genes are destiny. Instead, our characteristics depend on how our genes interact with our environment, and many genetic choices might be reversible with interventions later in life, from turning off the gene expression to using medicines that offset the genes' effects. Moreover, to the extent Habermas is right that the selection of our genes restrict our ability to author our own lives, the problem is that a lack of parental selection does not mean that children get to choose their own genes. It would instead mean their genes would be chosen for them by a combination of random luck and their parent's selection of mates. Thus, if choosing our genes is necessary to author our lives, we have not been authoring our lives all along, and will not be harmed if our parents pen a few lines. Indeed, if Habermas is right that choosing our genes is necessary to author our own lives, then his argument actually provides an important affirmative argument for encouraging human enhancements that alter the genes of adults, because those would be the only true way to author our own lives. In any event, once we gain the technology to influence the genetic makeup of our children, we will not be able to

avoid responsibility for our parental choices regardless of what we do.[40] Our child may be upset that we chose to give her a gene for great mathematical ability, when she instead turned out to want to be an artist. But she would also have a complaint if we failed to give her the math gene and she wanted to be a mathematician.

The arguments that human enhancement is bad because we will change ourselves in ways that make our experiences less authentic or shallower raise serious concerns, but seem to me to conflate what we might do with what we are actually likely to do. After all, if we think that a given human enhancement is bad because it degrades persons in these ways, why would we have any incentive to inflict such "enhancements" on ourselves or on our children? I share the revulsion of most readers to the "happy slaves" of the Brave New World. But if such revulsion is how most of us react when we read a fictional account of such a condition, one would think we would be even more repulsed by seeing the reality of it. It is hard to imagine my neighbor choosing to become a happy slave, and me thinking, "Ooh, I have to get that too." To the extent some human enhancement would be bad because they degrade our lives, then we would be able to see that the enhancement has bad results, and decline to undergo it ourselves. If some choose human enhancements even though some scholars might view them as inauthentic or shallow, then it must be the case that the individuals choosing those enhancements disagree about those conclusions or feel they are offset by other virtues. For example, while some scholars disdain Prozac as separating us from the real world, others think that Prozac frees them from a depression that was preventing them from being their authentic selves.[41] The key to the Brave New World problem is that there a central government inflicted these degrading enhancements on the populace. To be sure, the Brave New World enhancements were designed to make people happy in their degraded state, so that once in it, people would not want to leave it. But that does not mean people who were not in such a degraded state would voluntarily choose it. Indeed, in the book that status is rejected by the savage who had not been conditioned to prefer being a happy slave. Even if human enhancements allow us to choose our own future preferences, we will have preferences about the preferences we want to have. There is no reason to assume we will usually choose to have easily satisfied preferences, like choosing to be a pig rather than Socrates.

[40] Coady, *supra* note , at 174-75.
[41] Parens, *supra* note , at 186.

Distorted Incentives

We need a different theory if we're going to explain which biological interventions to approve and which to disapprove. The main clue to an answer, I will suggest, comes from focusing on situations where we cannot trust individuals to weigh the benefits and costs of their biological interventions because many of those effects are external to them. In particular, sometimes part or all of benefits are transferred to them from others or part or all of the costs are shifted from them onto others. As a result, individuals who consider only the benefits and costs they personally experience will agree to biological interventions that impose a net harm, often including a net harm on themselves once one considers that other individuals will undergo similar biological interventions that inflict a net harm back.

Consider the beta-blocker puzzle. In deciding whether to use beta-blockers, both athletes and musicians are likely to consider whether the benefits to themselves exceed the health risks. The health risks and costs are identical in both cases given the use of the same drug. The personal benefits may also be similar in magnitude. But those benefits different significantly in character.

In sports competition, the benefits to the beta-blocker user reflect a transfer of benefits from others. Only one athlete can win each Olympic medal. If one athlete wins by taking a beta-blocker, then that merely transfers that benefit to the using athlete from some non-using athlete. The use of the beta-blocker may seem like it has a large benefit to the individual user, but it creates a zero total benefit to the set of all persons. If the other athletes respond by also taking beta-blockers (as they are likely to if it becomes permissible), then all the athletes will have their accuracy improved similarly, and the beta-blockers are unlikely to alter who wins. If so, then beta-blocker usage will provide not only zero total benefit to all athletes, but zero individual benefit to each athlete as well. Each athlete nonetheless will have incentives to take the beta-blockers because the individual athlete considers only whether the benefits he personally experiences from his own individual use outweigh the health risks and costs to himself. The collective result is that athletes suffer health risks and costs in return for zero total and perhaps zero individual benefit as well. Those health risks and costs may not be large, but suffering them for zero benefit is something we should want to deter.

In classical music, in contrast, the benefits of taking beta-blockers during musical performances are not mainly mere benefit transfers. To be sure, there are only so many slots on each orchestra, so that part of each musician's motivation for taking beta-blockers doubtless reflects benefit transfers. But beta-blocker usage also creates a powerful absolute benefit even if *all* musicians use them: their

performances sound better to audiences. Given this significant absolute benefit and the small health risks and costs, it seems quite plausible that most musicians who use beta-blockers during performances would still choose to do so even if they enjoyed none of the transferred benefits. We thus lack a strong reason to deter the classical musicians from routinely using beta-blockers during performances.

Here, then, is the central idea of this book. We should approve of efforts to re-engineer human biology whenever the absolute benefits exceed the costs, putting aside all transferred benefits but including all shifted costs. Absolute benefits are gains from human re-engineering that would be enjoyed even if others obtained the same biological improvement. In contrast, transferred benefits are gains from human reengineering that reflect transfers of value from others, and thus result in no value for anyone if everyone engages in reengineering with the same effects. Shifted costs are harms from human engineering that are inflicted on others, whereas unshifted costs are costs from re-engineering that the user suffers personally.

Usually, the best test of which is whether this standard is met is to ask whether the persons being re-engineered would still do so without any transferred benefits or ability to shift costs. At least, this test works as long as those persons enjoy all the absolute benefits, perhaps because they have been impounded into the price for those persons' services. If some of the absolute benefits are conferred on others in a way that the persons cannot be compensated for, then the ultimate question is whether the total absolute benefits exceed the costs.

When the persons being reengineered do experience all the absolute benefits and costs, and would be willing to engage in such reengineering even without any transferred benefits, then the effects are likely to be desirable because individuals have incentives to engage in such reengineering only when the total benefits exceed the costs. But because people have incentives to engage in human reengineering whenever their personal benefits exceed their personal costs, reengineering that has external effects can lead rational persons to make decisions with undesirable consequences that merit regulatory sanctions. When individuals would not engage in reengineering without transferred benefits, then the reengineering creates net social harm and can even lead to collective action problems, where everyone feels pressured to engage in reengineering that in the end leaves everyone worse off. The same follows when individuals would not engage in reengineering unless they ignored the costs shifted onto others.

I will be the first to concede that this approach does not avoid the need for judgment. But in many cases it does not require open-ended normative judgment,

so much as it requires empirical judgment. For example, in our case of beta-blockers, one might object that the benefits of more accurate pistol shooting or archery are not purely transferred benefits. There might be an inherent beauty in seeing a distant target hit so accurately that audiences enjoy, much as they enjoy the wonderful tones of exquisitely performed music. My own sense is that this is not a large factor because the audience value from watching a sporting event is largely from the competition itself; otherwise people would be equally happy to see demonstrations of shooting or archery prowess that involved no competition. In contrast, audiences who watch classical concerts are not watching any competition for spots on the orchestra; all their value is derived solely from how beautiful the music sounds. But who am I to judge the purely aesthetic value of accurate shooting and archery? And why should anyone be able to impose on others their opinions about such open-ended value judgments?

Luckily, in this sort of case, implementing my theory requires no such imposition of value judgments on others. It asks instead what is really a factual question: would the individuals undergoing the biological intervention at issue really still choose to do so if they ignored the transferred benefits or considered the shifted costs? The answer to that factual question turns on how those individuals would weigh the absolute benefits and costs, not on how I or the rest of society would. To the extent that the issue is whether an individual should regard her actions as morally wrongful, subject to internal moral sanctions, the individual will have access to the relevant facts. To the extent the issue is whether others should regard an individual's actions as wrongful in a way that justifies the imposition of legal or social sanctions, we are unlikely to have clear empirical evidence on the issue, and thus we will have to rely on educated judgments of empirical plausibility. But such empirical judgments differ from imposing open-ended value judgments on others, and we may sometimes have empirical evidence that bears on the question.

The theory here is related to preceding work that has noted that many human enhancements raise a problem of "positional goods."[42] However, my theory differs from that preceding work in three ways. First, prior work making the positional goods argument against human reengineering has defined the problem as the pursuit of goods whose only advantage is positional. Here I aim to generalize the problem to include cases where the benefits are partly transferred and partly absolute, arguing that what matters in such mixed cases is whether the activity would occur without the transferred portion of the benefits. Second, my analysis is

[42] Peter Singer, "Parental Choice and Human Improvement," in *Human Enhancement* 277, at 282.

also more general in that it also includes certain other cases where costs are shifted to others. Third, while others have listed positional goods in a list of alleged arguments against human enhancements, my argument is that the related problem of transferred benefits and shifted costs is the only one that really justifies any regulatory limit, and that the exclusivity of this justification fits our actual pattern of social practice.

For beta-blockers, it seems empirically likely that few Olympic athletes would choose to use beta-blockers without the transferred benefits. For the vast bulk of athletes, the transferred benefits would thus be necessary to explain their choice to use beta-blockers, which justifies condemnation. The trickier issue is why this judgment should be imposed on the minority of Olympic athletes who do have heart conditions, because for them it seems clear that they would use beta-blockers even if they did not gain any transfer benefit. I think the reason is administrative. Although such athletes are not engaged in wrongful conduct, the Olympic authorities cannot be sure who they are. If the Olympics modified the therapeutic use exception to allow drugs even when they conferred a significant performance advantage, then many other athletes would likely pretend to have the relevant health problem in order to use a drug that gave them a significant performance edge. Thus, the only way to be sure the absolute benefits exceed the costs is by denying access to the transfer benefits by excluding athletes who take beta-blockers (or other drugs) when they confer a significant performance advantage. Further, if the Olympics did allow such athletes to compete, it would come at the cost of either giving them a performance edge over other athletes or (if to avoid this, the others were allowed to take the drug too) inflicting health costs on all the athletes as a group without changing the total benefits. Such administrative reasons also explain why the Olympics excludes athletes who were unaware that they were taking a performance-enhancing drug.

For musicians, the story is different because, even for the majority that lack any heart problems, there are significant absolute and transferred benefits to using beta-blockers during performances. Perhaps some musicians would not use beta-blockers without the transferred benefits, which may explain why a minority do raise ethical objections to their usage. But given the large absolute benefits and small health risks and costs, it seems quite plausible that most musicians who gain a performance benefit from beta-blockers would use them even if they ignored the transferred benefits. Or at least that possibility seems sufficiently plausible that musician beta-blocker usage fails to provoke the level of ethical outrage that leads to any rule or strong social norm against it

Such judgments justifiably turn on context because the context determines

whether there is a problem of transferred benefits or shifted costs that raises a concern. As the beta-blocker puzzle illustrates, there thus is no categorical answer to the question whether using beta-blockers to gain a performance advantage is wrongful – it all depends on whether the context suggests that the decisions would not have been made without transferred benefits or shifted costs.

Indeed, there is also no categorical answer to the question of whether using beta-blockers is wrongful when used the enhance a particular type of activity. Suppose, for example, that a modern-day William Tell was putting on exhibitions of shooting or archery, whereby he shot an apple off of the head of his son. Would we have any objection if he took beta-blockers to steady his hand? I think not, at least not if the beta-blocker usage is disclosed to any paying audience, because he is not gaining a transfer benefit from some other competitor. He thus must believe the absolute benefits exceed the health risks. Nor do I think the answer differs if the stakes of missing were lowered by, say, putting the apple on the top of a stick rather than his son's head. The lack of transfer benefits would still give us confidence that the absolute benefits of the shooting spectacle must have exceeded the health risks. Or, to take a more likely example, suppose police officers began to use beta blockers because the reduction in hand trembling enhanced their accuracy when using their pistols, making them less likely to shoot people accidentally. It is hard to imagine we would condemn this usage because there is no transfer benefit, only a large absolute benefit that likely exceeds any cost.

Likewise, varying the facts of the classical music case could reverse our judgment about it as well. Suppose, for example, that Sally was a classical musician who used a beta-blocker *only* during her audition and never used it during orchestra performances. That would be wrongful because then the benefits to Sally would be almost entirely transferred (from the musician she beat out) because the audience would never experience her enhanced performance. Indeed, the audience will likely experience a worse performance because Sally will have beaten out a rival who would have given a better orchestra performance that Sally will without beta-blockers. This does not mean that Kenneth Mirkin was wrong to use beta-blockers during his audition, assuming he continued to use them during orchestra performances. The reason is that, if a musician does use beta-blockers during his orchestra performances, then using them during his audition will provide a better test of how he would actually perform. The problem arises only if beta-blockers are selectively used for auditions, for it is only in those cases that beta-blocker usage creates mainly transfer benefits and is likely to worsen orchestra performances.

This theory turns out to explain a lot more than just the puzzling case of

beta-blockers. In the chapters below, I will use it to also explain commonly held intuitions about the use of attention-deficit drugs to improve SAT scores, steroids to compete in sports, growth hormone to increase size, plastic surgery to improve looks, selecting the sex of children, and cloning. In short, I aim to provide not only a normative theory of when we should approve or disapprove of human re-engineering, but also a descriptive theory of when we seem to actually do so. The normative theory thus draws strength from its correspondence to existing social practice in response to past biological interventions. This normative explanation of our existing social practices, I will argue, provides our best basis for making distinctions among the vast set of new powerful biological interventions we are on the brink of discovering.