

CATO INSTITUTE

BOOK FORUM

THE GENETIC FUTURE IS NOW

Redesigning Humans

vs.

Regulating Science

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Moderator: Tom Miller, Director,
Health Policy Studies, Cato Institute

Featuring:

Gregory Stock, UCLA School of Medicine; and
Francis Fukuyama, Johns Hopkins University

The Cato Institute
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P R O C E E D I N G S

DR. MILLER: Good morning. And welcome to March Madness at the Cato Institute. Or if you prefer a different pop cultural allusion, Freaks and Geeks Revisited.

I'm Tom Miller, Director of Health Policy Studies, at Cato.

Our tip-off this morning matches two authors, both number one seeds, Gregory Stock of UCLA and Francis Fukuyama of Johns Hopkins. They're here not just to sell their respective books but their quite different views of our genetic and post-human future.

About three decades ago, George Allen came to Washington as the new head football coach of our key cultural institution, the Redskins. He announced that the future is now. He could only rely on signing aging veterans in return for future draft choices. If only he could have reengineered the genes of the over-the-hill gang.

Well, the genetic future is now, too, with an incredible array of discoveries, techniques, and revolutionary possibilities on the doorstep. And the science is increasingly intermingled with heated politics that reflect flashes of interest and values.

Within the next month or so, if not earlier, the Senate is expected to vote on legislation that might prohibit human cloning. That will be similar to House legislation that was approved last year. An alternative measure in the Senate would draw a distinction between cloning for reproductive purposes and cloning for therapeutic purposes, permitting continued research for the latter.

The cloning controversy follows on the heels of last year's stem cell research debate, and not far ahead are issues of genetic engineering and designer babies. Regardless of how this particular political skirmish turns out, the folks in the biotech labs have been cooking up an amazing concoction of future possibilities that could transform human society in many dimensions.

As the science fiction frontiers come closer to everyday reality, they challenge our views of the role of politics and government and scientific research and development, our fundamental philosophies and values, and ultimately our conception of human nature. In our country, and across the world, individuals are divided, or puzzled, in trying to make sense of what lies ahead. So we might not be able to wrap this one up in a neat package over the next 90 minutes and settle all disagreements, but we have two of the premier thinkers in this complex, multidimensional field of inquiry.

For our format today, Dr. Gregory Stock is up first, under the alternate possession rule. Frank Fukuyama will follow. We will have a brief rebuttal round and then move to a more open-ended exchange between the two authors before bringing in your questions, comments, and I suspect a few short speeches.

Greg Stock is optimistic about our inevitable genetic future. He believes strongly that the genetic future has arrived and the opportunities far outweigh the risk. Greg is the Director of the Program on Medicine, Technology and Society at UCLA's School of Medicine. His new book, on sale here and due in bookstores next month, is called "Redesigning Humans." It's published by Houghton Mifflin Company.

Greg would fall into the early adopter/beta tester group of technophiles I believe. His larger role is to explore critical technologies poised to have major impacts on humanity's future, the shape of medical science, and the thrust of biotechnology. He is particularly interested in the Human Genome Project and its spin-offs in reproductive biology, genetic testing, drug development, health care policy, and medical practice. He is the author of many books, including the bestseller, "The Book of Questions." Dr. Stock holds a doctorate in biophysics from Johns Hopkins University and an MBA from Harvard. He is now a professor in the Department of Psychiatry and Biobehavior at UCLA.

In looking at how we deal socially and politically with our genetic future, Greg urges that a free market environment, with real individual choice, prudent oversight, and mechanisms to learn quickly from our mistakes, is the best way to protect us from potential abuses, and channel resources toward the goals we value. Well, Greg, you're here at Cato today, where those types of thoughts are expressed on many other policy issues.

Is biotech and genetic modification different in some way that challenges many Americans basic philosophies of individual autonomy, laissez-faire economic relationships, and broad scientific inquiry? What makes people either afraid or uneasy about what lies ahead?

Greg Scott.

(Applause.)

GREGORY STOCK,

UCLA SCHOOL OF MEDICINE

DR. STOCK: Thank you, Tom.

It is a real pleasure to be here this morning to have a chance to talk to you about biotech policy and some of the implications of the Human Genome Project. And it is a particular pleasure for me to be able to have a more formal exchange with Professor Fukuyama, who I have dealt with on a private basis. We

have discussed these things many times, and I certainly very much respect his thinking in this realm.

But Francis Fukuyama and I have a very different vision of the human future and how to navigate our journey ahead. We share an understanding of the immensity of the implications of the Human Genome Project and are beginning to decipher and manipulate human biology. We also think about the need for some sort of oversight in this realm. But whereas he sees it as being quite urgent that we develop, or we essentially erect, a rather strong regulatory infrastructure, one with real teeth that can guide us on this path, I am very, very hesitant to invoke legislative solutions and to try and direct our path.

I feel that we need to be very cautious about this, especially prospective legislation which deals with not real problems that we are facing at the moment but with sort of imagined ones that may develop, and particularly when this deals with restrictions upon basic biological research, which I think is very mistaken and will lead to very serious problems.

Before we get into a discussion of some of the possibilities of how this might be controlled or not controlled and where it might lead us, let's take a look at the big picture. I want to give you a feel for the immensity of what is occurring. And I think that the best way of doing that is to think about the two unprecedented developments that are occurring today. The

first of these is the silicon revolution. And we just have to look around us to see how that has reshaped our lives -- telecommunications, the Internet, the beginning of having intelligent devices in our lives.

What has happened is that we have essentially taken the inert sand at our feet, the silicon, and breathed into it a level of complexity that rivals that of life itself. And this is obviously going to have continuing increasing effects on our lives.

The second revolution is the genomics revolution. And by the "genomics revolution," I mean all of the attendant biotechnologies that are emerging in that realm as well. And what is happening here is that we are learning to understand our biology and to adjust and alter it in various ways. And the impact I think is even going to be greater than the silicon revolution. Because we are going to be able to begin to exert control over our own evolutionary future. This is really a big thing.

Now, genes are not our destiny; that's clear. But they do tell a great deal about our predispositions and about our vulnerabilities. And as we learn to alter them, to adjust them, we are no longer going to be slaves to the genetic lottery. And you know that that can be very, very cruel at times. And it is

clear that we devote enormous energies to trying to overcome problems that emerged from genetic diseases.

Soon we are going to be making very critical decisions about our biological constitutions and changes that we might make in it, and also about those of our children. And ultimately, these possibilities are going to both transform health care and medicine. They are going to alter the way that we have children or that we conceive our children. They are going to give us increasing control over adjustments or modifications to our moods and our emotional states. And they could quite feasibly increase the human lifespan itself. This is really big stuff. It is coming very quickly. And it is going to bring into question the very meaning of what it is to be a human being.

It's scary. And that is why it is tempting to try and say we have to control this, we have to stop it.

There are two waves of change that are going to be arriving. The first is going to be in the next 5 to 10 years. And that is going to be as a result of our ability, using DNA chips and other technology, to essentially look at our genes in a very detailed way and to see what they tell us about who we are -- not only our vulnerabilities but various aspects of personality as well.

And this is going to lead, I believe, to things like a huge shift in medical care towards preventive medicine. Because

as we find out what our risks are for various kinds of diseases, well, we are not going to just look at that information and ignore it; we are going to want to do something about it. And that is going to bring up big social challenges as well. Who is going to pay for this, what are essentially elective and preventive measures in medicine?

But the second wave of changes that will arrive in force in about a generation are going to be much more challenging for us. These involve adjusting certain aspects of our own biology. And I don't mean adding gills or an extra pair of arms or something. But I'm talking about things like if you could actually go and retard the process of aging, so that you would extend the period of human vitality and lifespan. This would change virtually everything about the way we see ourselves and about our society. And there are mainstream researchers in the biology of aging today who believe that the first person to live to be 150 years old is already alive.

The second is in managing our emotions. Ritalin, Prozac, these sorts of things, these are just the baby steps that we are taking. What if you could have a pill that you could take that would make you feel really contented, and it didn't have any other physiological side effects? Would you be able to resist that? And if you didn't, then who would you be? What would motivate you to do what you? So that's another big area.

The third big area, which I'll talk about in more detail, is changing human reproduction. Because as we understand the constellation of genes that contribute to our makeup and to shaping who we are, well, we are going to want to make decisions -- if we get that information about embryos -- we are going to want to make decisions about the genetic constitutions of our children. And the focus of my book is really what the implications of that are, what kinds of decisions people will be drawn to, what the social consequences might be, and what that will look like.

I think this is the most challenging realm, because this passing of the torch of life from one generation to the next is really so integral a part of how we see ourselves. And there are several ways of influencing the genetics of our children in a direct way. The first of these is the one that has been in the news so much -- cloning. In my view, cloning is a complete side show. It's too dangerous to do for now. It has never been done in a primate yet. It eventually will be. And it seems to me extremely unlikely, regardless of what legislation is passed, that a human being will not be cloned within 5 to 10 years.

And when it happens, it is not going to be that big a deal. The production of a delayed identical twin is strange and different. And it seems to me that it is just not something that is going to shake the foundations of our society and not

something that is going to be extraordinarily popular; that it will be sort of a niche technology.

The second technology is embryo screening, where you go in and you take an embryo, a six- to eight-cell embryo, and you tease off one of those cells, you do genetic tests on that cell, and, depending on the results of those tests, you either implant or discard that embryo. This has already been done. It is very safe and reliable. It has been done by parents who are worried about their children, who are at high risk of bearing a child with a serious genetic disease -- like cystic fibrosis or Tay-Sachs. And it has been used effectively to allow them to have children with essentially normal genetics.

Now, the challenge comes in that the scope of genetic testing is going to rapidly become such that one can make much more nuanced choices that move beyond simple very serious diseases into choices about who that child is likely to be. And I think that this is going to be very, very potent stuff.

The third way is through genetic engineering, direct interventions that alter the genes of the first cell in the embryo. This is something that is a little more distant, but not that much more distant, and is likely to come quite naturally out of embryo selection I believe.

So the question is: Should we go down this path?

Well, I think that it is a misplaced question, in that we don't have any choice. The reason that it is inevitable that we are going to use these technologies, especially the reproductive ones, is that polls show that at least a sizable minority of individuals, of parents in every country surveyed, say that if these things were safe and reliable they would be very interested in actually enhancing the physical or mental capacities of their children.

The second is that this is just a spin-off of mainstream research. No one has to actually be actively pursuing these things. They are going to grow out of medical research that we all support.

And the third is that these technologies, as they develop, are going to be rather widespread and they are going to be available in thousands of laboratories all over the world, and it will be very difficult to identify when they have been used and to regulate them.

So the real question for me, with these sorts of reproductive interventions, is not whether they are going to happen, but whether it is simply going to be the wealthy who have the ability to ensure the genetic welfare of their children, or whether we are going to have a very serious dialogue about how we might be able to make these sorts of choices available to people broadly.

Let's return to inevitability, though -- the notion that these things are bound to happen. Some people say that they won't happen, that we have a choice. Well, the only ways that I can see that this wouldn't happen are three. First of all, that the science does not pan out. That basically the human genome is too complicated to see these relationships, and we can't either interpret it to make guesses about who future children will be, or that it's too complicated to manipulate. I think that this is rather unlikely. And there are many indications, and they're only indications at present, that there are some things that are too difficult to do; there will be other things that are rather difficult, that are hard; and there will be other things that are surprisingly easy.

For instance, if you take a fruit fly, you can change a single gene and double its lifespan. This is an extraordinary intervention, with a single gene. And it is not going to be that simple, but these are the kinds of things that may be possible.

The second is that we voluntarily turn away from this stuff. We say this is too dangerous, we shouldn't go there. I think that that is even more unlikely. Because, after all, we are human, and lots of people -- not everyone -- would not mind being a little healthier, living a little longer, maybe being a little more talented. And if they cannot have it themselves, they would like to give those advantages to their children.

There are instances after instances of demonstrations that this is in fact the way people behave.

The third is that we block this technology, or very tightly channel it. I think that that attempt will be futile and that it will be damaging as well. Because it will pass development off to groups and countries and individuals who are probably not going to be very responsible about it. It will drive the technology underground and out of sight, where we cannot see the mistakes that are made -- because there will be mistakes that are made. And it is going to reserve it for the wealthy, because I believe that they will be in a position to circumvent any constraints that we apply.

Just as with abortion, if you make abortion illegal in one State, it doesn't stop the wealthy from just traveling to another State to have the abortion that they seek.

So I think that we need to be very pragmatic about this. We need to recognize that these are going to be extremely challenging and uncomfortable developments that we are facing, that there is going to be no consensus about them, that they touch our values too deeply. However long we talk about them, we are not going to come to agreement about how to handle these things.

The second thing we need to realize is that the immediate dangers, other than the philosophical and abstract

ones, are really rather modest. This is not nuclear weapons, where an accident is going to kill millions of innocent bystanders. Basically, the early use of these technologies is going to come from very eager volunteers, who are probably quite wealthy and well educated about what they're doing. And they will be humanity's guinea pigs essentially.

The third is that we simply do not have enough knowledge to know how best to enhance the beneficial possibilities at this point and to constrain the side effects that we really don't want to see happen. And the only way we are going to get this information is through really keeping in touch with what these technologies are actually able to achieve and with seeing problems that develop.

The biggest danger, in my view, is that we overreact because of the larger social and theological issues associated with these things, and we actually restrict the kinds of medical research that will bring about cures or treatments for various diseases that are clear and present dangers to large numbers of adults who are suffering from them. I want to repeat that humanity is going to explore this realm. It is not space that is our next frontier; it is our own selves. It is going to be a very challenging exploration for us, and it will require our wisdom to do this.

And our critical choice is not how we handle cloning or stem cell technology or genetically modified foods or any particular technology; it is whether we have the courage to face this very open-ended and uncertain future that is coming towards us; or whether, out of fear, we pull away from it and try and block it or not participate in it, and essentially turn over its development to other braver souls in other regions of the world. Because there are very many people, there are very many groups, including especially China and other areas in Asia, that would be happy to jump in and take leadership in this central development in the human future.

Thank you.

(Applause.)

DR. MILLER: Thank you, Greg. So, I've got that right? It's the human genome's inner space, the final frontier, to boldly go where no man has gone before, splitting infinitives, et cetera.

Well, not so fast on the optimism, says Frank Fukuyama. We need to lay down some political markers, to point out that development of these technologies is not inevitable and not necessarily desirable across the board. His new book, "Our Post-Human Future: Consequences of the Biotechnology Revolution," will be out next month, published by Farrar, Straus and Giroux. He argues that, even if we can change human nature,

we need to pause and reflect before we do it, if at all. We may have dodged the vision of "1984" in the last century, but the brave new world ahead still holds open a range of more seductive dangers.

Dr. Fukuyama suggests that we find a middle ground, based on new regulatory institutions that would neither permit everything nor ban all cutting-edge biotechnology research that bumps up against many other values and beliefs. To update Dionne Warwick and Burt Bacharach in this area: What the world needs now is reg, sweet reg -- that's the only thing that there's just too little of.

We've got to get these boomers all on the same page.

He asserts that the genetic future envisioned by enthusiasts like Greg Stock is not inevitable. Science, by itself, cannot establish the ends to which it is to be put. We need theology, philosophy, or politics to establish the ends to which its technology is directed.

Frank Fukuyama is the Schwartz Professor of International Political Economy at the Nitze School of Advanced International Studies at Johns Hopkins University. He was formerly the Hearst Professor of Public Policy at the School of Public Policy at George Mason University. And, most recently, he was appointed to the President's new Council on Bioethics.

Dr. Fukuyama's most notable book, "The End of History and the Last Man," was published by Free Press in 1992. It has appeared in over 20 foreign editions. Evidently, history just took a pause until it could install some new software and get a tech upgrade.

His next book was "The Great Disruption: Human Nature and the Reconstitution of Social Order," and now we have his latest book, looking at our genetic "Post-Human Future."

Dr. Fukuyama has written widely on issues relating to questions concerning democratization and international political economy. In recent years, he has focused on the role of culture and social capital in modern economic life and on the social consequences of the transition into an information economy.

He received his B.A. in classics from Cornell University and his Ph.D. from Harvard in political science. And in the early eighties, he was a member of the Policy Planning Staff of the U.S. Department of State.

Frank, we've got all this neat stuff that can make people healthier, feel better, live longer; why should these old notions about human nature, human moral sense, and our shared humanity -- to throw in a little Aristotelian philosophy -- stand in the way of all this good stuff?

Frank Fukuyama.

(Applause.)

FRANCIS FUKUYAMA,
JOHNS HOPKINS UNIVERSITY

DR. FUKUYAMA: Thanks very much for this opportunity. This is actually the first time I've seen a copy of my own book, so I'm very pleased to be able to participate in this debate.

I should say at the beginning, since I see a couple of staffers from the Bioethics Council in the audience, that I am not speaking on behalf of the Council. I am speaking on behalf of myself alone. And I'm really happy to have this opportunity. Greg and I have talked about these issues privately, and I am happy to have the opportunity to do this in public.

I think that Greg's book is actually very useful, because he makes explicit a lot of things that most other researchers in the field, and a lot of people in the biotech industry, aren't willing to say. I think that most people will make much more modest claims for the future possibilities of the science; for example, the idea that you will actually get into human germline engineering.

Greg very bravely sponsored a conference on germline engineering at UCLA a few years ago and, as I understand it, a lot of people were quite nervous about doing that, because they think that this is such a science fiction-like frontier that it

will scare so many people. And a lot of scientists I think genuinely don't believe that we will ever get to this particular future. But I think that he is right, that this is the single most important issue -- the question of redesigning human beings and redesigning human nature.

I think that all of the present-day issues over stem cells and cloning are really not, in the scheme of things, all that important. They are important as the early markers, or the down payment, on what is a much larger set of technologies that will be coming over the horizon. And I, frankly, would say that my interest in any of the near-term issues is only with respect to how they will affect the outcomes that will perhaps not arrive for another 10 or 20 years, but I think are far more consequential -- which is this issue of human genetic redesign.

So, let me just go over some of the reasons that I lay out in the book for why I think deliberate human redesign or, as Greg says, human beings taking control of their own evolutionary process, could be dangerous, or at least much more dangerous than we have seen in something like agricultural biotechnology, where this is already done routinely.

First of all, the challenge I think is a genuine one. And particularly at a Libertarian organization like the Cato Institute, I think you can make the following argument, which Greg lays out very clearly in his book. The old form of

eugenics, which we all agree was a very nasty thing, was state sponsored. It involved the deliberate breeding of people, but it involved, of course, the power of the state. Future genetics, or future eugenics, I think we will all agree, is not likely to be state sponsored, at least not in any liberal democracy where the technologies are going to be developed.

It is going to be used by individual parents, who will make individual decisions that will presumably be for the benefit of their children. And since we can assume a community of interest between parents and children, since parents don't do things to deliberately harm their children, I think the very challenging question is: What's wrong with that? Why do we think that there are reasons that this will lead to a dangerous future, if the state stays out and it's simply a matter of individual choice?

I think that there are at least three categories of problems with this, even under this scenario where the state is not involved in eugenics, which has to do with purely utilitarian kinds of concerns. Secondly, I think there is some genuine ambiguity as to what constitutes human improvement. And thirdly is a much more basic moral issue which has to do with the fact that human rights, our very understanding of human rights, arises out of what our human natures concretely are. Therefore, if you

change human nature, you undermine our present understanding of rights.

Let me go through each of these in turn. Let me just begin with the most straightforward, utilitarian concerns, which I think would be the angle that most people would take in questioning the possibility, say, of a future germline technology that could actually splice genes the way we currently splice genes with Roundup-ready soybeans or other agricultural biotech products. I think, and Greg acknowledges this in his book, that the safety problems are likely to be much more severe simply due to the complexity of genetic causation.

The estimate of the number of genes in the human genome has bounced around. Now they are tending towards lower figures, as low as 30,000. Particularly if the number is that low, it seems to me the complexity of how we move from a DNA molecule to a complex organism, in a sense, becomes much harder to understand. Because there are clearly multiple genes that have a single effect, or a single gene that has multiple effects. And when you get up to higher-order behaviors, understanding the actual causal pathways that gets you from the molecule to the final behavior is likely to be unbelievably complex.

And I think there are many other instances in the history of medicine, a lot of drugs, like Thorazine, that we thought we understood but, a generation later, turned out to

produce side effects that had not been anticipated. If you think that those kinds of problems have already been severe in drug approval up to this point, they are going to be enormously more complicated when you get to germline engineering. Because a lot of the problems will not show up until perhaps a later stage of an individual's life, possibly not until the second or third generation, until that individual reproduces. And so how you actually vouch for the safety of these particular procedures is something that I think is very difficult to understand.

Greg, in his book, gives an example of, let's say, a molecular intervention that will prolong aging. He mentioned a single gene that doubles the lifespan of a fruit fly. So, supposing that someone comes up with a similar gene or group of genes in a human being that promises to double human life spans. Just think about what the drug approval process for this would look like. You are not even going to know whether this thing works until 60 or 70 years down the road. Because if it's a life extension therapy, you have to see what the normal life of this particular individual is. You are not going to be able to experiment with this thing. There are not earlier versions of the experiment that you can run on human beings.

Some parent is going to have to say, well, it was done safely in a mouse, and so therefore I am going to do this to my child and accept the risk that this will work out. And I think,

under those circumstances, as much as people want long and happy lives for their child, if you went to them and realistically said, well, you can do this, your child may actually live to be 150 years old, but there is maybe a 25-percent chance that the last 50 years of that life will be spent in a nursing home in a vegetative state, but you're free to do it, you be the beta adopter and let's see what happens, how many parents are going to do this?

Parents are willing to take very large risks for therapeutic purposes, if their child is likely to come down with Huntington's disease or cystic fibrosis or any of the other terrible genetic diseases that affect people, but for an optional enhancement, to undertake those kinds of risks, I really cannot conceive of people doing it. And actually that makes it an appropriate target for regulation.

Greg is absolutely right, if people really want it, it's safe and effective and everybody is going to do it -- like drinking alcohol under Prohibition -- then that is absolutely right, you cannot regulate it and it's hopeless to try. But in circumstances where things are actually a little bit dicey and there are risks and there may be some people that are willing to take extra risks, I think that's where we appropriately enforce a degree of social regulation.

A second utilitarian concern has to do with negative externalities. And here I think you can use a conventional economic framework for understanding this. Traditionally in economics, you regulate things, where the state has a role in regulation in situations where there are negative externalities. That is to say where there are third-party effects in a transaction, in an economic transaction. And I think you can imagine quite a number of situations where the individual decisions of parents will produce negative externalities.

One has to do with where the most important third party is actually the child. In a lot of the debates on cloning, people assume that this community of interest between parent and child will guarantee that the child will retroactively approve whatever experimentation is done on him or her by the parent, but I don't know that you can take that for granted. I don't know that you can presume consent on the part of a child to be born as a clone or as the genetic offspring of two women or any of the possibilities that exist right now.

On a population level, I think you have some fairly clear examples of negative externalities. In the early 1990's, there was something like 122 boys born for every 100 girls in South Korea. This was an individually rational decision on the part of parents, given Confucian culture and the role of boys in supporting parents in families. But on a social level it is

clearly negative. I don't know of a single better formula for social instability than to have one-fifth of your male population reach marriage age without being able to find a bride. That is where all of the war and revolution and crime and violence comes from is these unattached males. And that is a social cost that will not be borne necessarily by the individual parents making the decision but will be borne by the society at large.

A third example of a negative externality has to do with life extension. If life extension becomes possible, but with a reduced level of vitality or health or mental capacity -- which it seems to me is virtually inevitable, especially in the early stages of experimentation -- then society will have to bear the cost for having people, let's say, live 20 or 30 years longer but at a 20- or 30-percent reduced physical or mental level of capacity. Somebody is going to have to pay for that shortfall.

The second major category of dangerous has to do with our lack of understanding of what constitutes improvement. I think that when people talk about how great it will be to improve human beings, they are thinking about things like -- I don't know -- looks or intelligence, where there is a fair degree of consensus that it is better to be smarter than stupider. But I think that there are many characteristics that will become potential targets of enhancement, where it is not obvious what improvement constitutes.

This is particularly true when you get into things like the human emotional makeup and personalities. Our evolved selves are the very, very complex adaptations to a long-term social environment that involve a lot of tradeoffs between different kinds of characteristics. And I think that if you start playing with that complex whole, it is just like playing with an ecosystem; that if you change one thing in that, you end up having these very perverse side effects that you absolutely did not intend.

Plenty of people will be perfectly willing to venture opinions that boys are too aggressive or violent, that people are too competitive or they're not competitive enough, that women should be more assertive -- all of these things we are already beginning to try to manipulate through neuropharmacology -- and they will become targets of genetic intervention as well. And I just do not think that you can straightforwardly assert that some of the things that will be possible, that will be marketed as human improvements, will actually constitute that.

Let me just give you two examples. Are human beings improved if you eliminate all genetic propensity towards homosexuality? Would an African-American be improved if you had a genetic intervention that would make their child lose their skin pigmentation and look like a white person? Is that an

improvement? And if so, should people simply be allowed to do either of these freely?

A final issue, and, in general, is it seems to me we need a little bit of humility in dealing with nature. Reading Greg's book, in a way, reminded me of watching these early movies about the building of Hoover Dam and how we were conquering nature and how this was all the forward march of progress. I think one thing you can observe about technology, when you talk about the inevitability of technology, is developed countries do not build large hydroelectric projects anywhere.

You cannot find a single one that has been done in the past generation because of the complex environmental and social effects that these big hydro projects have. If you look back at these movies about the conquest of nature and the building of Hoover Dam, they look very quaint, because people simply did not understand what they were getting into in terms of long-term social, environmental, and economic consequences.

The last issue has to do with ethical concerns over the nature of rights. Human rights, as Thomas Jefferson said in the Declaration of Independence, are based on human nature. That is to say, what is typical for us as a species. Our most basic moral precepts are based on that species-specific nature, on our language, our reason, our capacity for wonder, for curiosity, for culture, for learning and education. All of these may lead to

cultural acquisitions over historical time, but they are the species-typical characteristics that we have that, let's say, chimpanzees don't have.

And even if 98 percent of our genomes are shared between us and chimpanzees, that unshared 2 percent is what is the basis of human dignity or everything that we think is important to us, that gives us the right to eat and skin and experiment on chimpanzees but doesn't give chimpanzees the right to do the same thing to us. Nor does it give us the right to do that to another human being.

Now, if you change nonessential characteristics, it's not going to matter that much -- you know, height or looks or skin color or things of that sort. But at a certain point you begin to muck around with things that come closer to what we would regard as the human essence. Now, what that human essence is, is very hard to determine. But it is of utmost importance, because it is really what gives us the feeling that we human beings, as a class, have a higher moral status than the rest of natural creation.

I think that the casual thought about, well, we'll just redesign who we are as human beings, doesn't understand that that opens the door to a kind of moral openendedness in which Nietzsche is a much better guide than John Stuart Mill or Bruce Ackerman or John Rawls or any of the current avatars of

liberalism. I think that the idea that you can start messing with this kind of thing and, for example, have politics remain simply in the framework of a nice liberal democracy that is tolerant and pluralistic, when in fact certain people are genetically altering themselves into a subspecies and other people to have highly enhanced characteristics, is just not realistic.

Our entire liberal democratic order is not going to withstand that sort of thing. And there will be plenty of excuses for the state to get back into the game of eugenics. The possibilities for very sophisticated kinds of political and social control and social engineering will once more be possible, where we thought that they were not at the end of the 20th century. So, all of this, I think, is politically extremely consequential.

So, the simple answer that I have to what you do about this is you regulate it. Now, I think you have to compliment me on my courage in coming to the Cato Institute and making a speech to you where I say that what the world needs is more regulation, but I just see no other way around it.

I do not believe that it is possible to ban large areas of scientific research. I do not think it is possible to ban things that are very popular and highly desired by a lot of people. And I am not proposing that. What I am proposing is the

need for thinking seriously through a regulatory structure that will allow us to make certain decisions to control and to channel the direction that this technology takes.

Greg's book is full of assertions that you cannot stop any of this, and I just don't know on what empirical basis you can say that. Because, in fact, we regulate biomedicine in all sorts of ways today. You can complain that it is over regulated or it does not regulate the right things or there are regulatory failures, but we regulate the progress of science and technology in a whole host of ways. And I think that the issue really is thinking seriously about what institutions would be capable of doing that.

For example, I believe that it is possible and desirable to hold a line between therapy and enhancement. I have no problems with germline therapies if they can be successfully proven, that will correct severe genetic diseases, and even some that are not so severe. But I would think that society should come to a great consensus that that was a legitimate use of this technology and that research and development ought to go into this area long before it goes into changing people's personalities or making them smarter or making them taller or adding enhancement characteristics, which are really purely optional for people.

Now, a lot of people will say you can't draw a line between therapy and enhancement. And I certainly understand that there are great difficulties in a lot of cases of doing that. I would just like to point out that we do this all the time, in our drug regulation, for example. A drug like Ritalin, which treats attention deficit hyperactivity disorder, is an amphetamine that is considered by the DEA to be a Schedule 2 pharmaceutical that requires a doctor's prescription in triplicate. The DEA controls the total amount of Ritalin that is produced in the United States every year. And it is banned for enhancement uses. It is permitted and very widely prescribed for therapeutic uses.

In my book I have a long discussion about whether we draw the line appropriately, because I tend to think it's over prescribed. But in fact that's a classic case of a socially constructed disease, where the line between therapy and enhancement is really not at all easy to draw, and yet we regulate it right now. And I don't see why we are not going to be able to do that with other kinds of much more questionable sorts of medical procedures, drugs, and interventions that are going to be coming down the line.

I think that it is not too early to start thinking about this. It is not a question of stopping science. I agree that no one can do that. It is simply making science the servant of human purposes rather than the reverse.

Thank you.

(Applause.)

DR. MILLER: Greg, why don't you take about five minutes for any follow-up thoughts.

DR. STOCK: I enjoyed that. Thank you, Frank.

I will make a few comments about some of the things that Francis has said. First of all, on his analysis of the issue itself, I would agree very much that safety is an area that is a major consideration for regulation. We do this in all sorts of technologies. We try and provide people with information about what the safety of various procedures are. And we even have cutoffs, in which we say that procedures are not safe enough to use.

I do not agree, however, about the complexity. Francis used genetic engineering, direct genetic interventions, as being a clear example of why this would be unsafe, but I think that many of the immediate applications would not involve safety issues whatsoever. If you look at pre-implantation genetic diagnosis, where you are taking a whole number of embryos and selecting one of those embryos, all of these embryos are natural. They are viable. There would be no issue of safety whatsoever, or very minor issues -- no more than exist with in vitro fertilization today -- and yet you would have the possibility of various enhancement procedures, where you select individuals

because of their likely capacities along one vector or another -- something that is appropriate, that you consider to be appropriate.

So, I feel that that is kind of a red herring, in a sense, the safety issues, because literally no one wants to use unsafe procedures, least of all parents. And until various levels of assurance can be provided, that procedures, especially what I would loosely term enhancement procedures, are very safe, the risk/reward profile of that is such that it would be used only in very fringe ways. Nobody is going to use those technologies unless they are safe.

The second area there is negative externalities. Well, here we had something like sex imbalances. And here was an example where a totalitarian government can't even stop its people from using relatively low technology -- ultrasound -- to make choices to destroy girl babies through abortions. So you can talk about sex imbalances arising -- in that situation, there are very many social reasons why that situation exists -- but evidence has shown that, in the United States, and in the developed world, these sorts of sex imbalances don't seem to arise. In fact, there is a slight tendency to pick girl babies more than boys.

As far as individuals, the threats to the individual, well, an overriding way of analyzing these things is, who is the

victim? And if you take sex selection, I think that is a particularly good one. For me, if a couple feels very, very strongly that they want to have a baby girl or a baby boy, I don't see who the victim is, to allow them to fulfill that desire. Certainly not the child, in my view. And I don't think it is the parents. And there may be social externalities that we need to address, but my view is to wait until they begin to develop. There will be ample time to try and develop policies that are directed towards the real problems that exist.

The other is the whole notion of enhancement and improvement. I don't look at this as some sort of a trip towards the brave new world, the ubermensch or something. I think that we are going to get enormous diversity, because individuals will make choices that virtually all of us are uncomfortable with and that are informed by what their particular orientations are, and those are quite diverse. Actually, there have been couples who are deaf, who say that what they would use this technology to ensure that their children will be deaf, to select embryos that are going to be deaf. I would guess that homosexuals, or gay couples, there may be many of them that actually choose to have gay children.

So, the choices are not going to be that we are going to walk in lockstep towards some sort of image of superior, blond-haired, blue-eyed superhumans. I think that that, again,

is really sort of a caricature of the possibilities of the future.

As to ethics, well, who decides what our species-specific nature is and what it dictates? Generally, these things come from very strong religious perspectives. And I think that the way that our species-specific nature is going to channel the future -- or a more effective way to do that -- is through our choices. We have values, and certain things appeal to us, precisely because we are human. And this does open a door to -- we're not sure what -- but that door is really already open.

And the future, even if we were to stop all progress in biotechnology or all research in biotechnology, I think that we would still be facing a very strange future. Because developments in computers and in other realms are going to be very challenging for us and for our visions of who we are.

So, we get to regulation, which I think is what is really the issue. Not that there is going to be no regulation. I don't believe, and I don't think anybody believes, that in our society as it exists today anybody is going to say there should be no regulation of this whatsoever. The technologies are too powerful. But in fact, the question is: What is the goal of our regulation?

What are we trying to accomplish? Are we trying to ensure that there is safety, that when individual parents are making choices about their children that they are able to make informed decisions and that we essentially leave them alone except when there are really egregious choices that they are making that are going to clearly be very damaging to their children? Are we doing it to try and protect social order in some way, some theological sense of playing God, that we don't want to do those sorts of things?

I think that is really the challenge. And I hope that we can get into specifics and take very specific examples in how we would try and regulate these sort of things. I think that is very important. Because when you look at our regulatory successes in the past -- I look at drug regulation as a disaster. Here is a situation where there is something that is clearly deleterious, very negative, and we cannot control it at all. In fact, we have really torn at the fabric of our society by trying to do this, and done so in very, very deep ways.

I think that as far as our being able to regulate, and that we do this all the time in biotechnology and medicine, sure, there is all sorts of regulation going on. I think that the overall trajectory of what the possibilities are that are emerging out of biotechnology and out of biomedicine are not being shaped by the regulatory infrastructure that is in place

today. That is largely to protect individuals from incautious use, from human experimentation, from those sorts of things. And I would favor that type of continued regulation that exists today.

Let me close with this. The question is really, if we are going to erect these regulatory structures that would be international in scope and therefore rather oriented in larger policies that are sort of uniform in some way, I would challenge you to be more specific about the way you would regulate specific technologies, like sex selection, or pre-implantation genetic diagnosis -- embryo selection -- where in fact there are no safety issues whatsoever.

DR. MILLER: Thanks Greg.

Frank, do you have some particular follow-up comments?

DR. FUKUYAMA: Just on that last issue. As I said, I think it is reasonable to draw a distinction between therapy and enhancement, initially. As I said, there are a lot of ambiguous cases. But it seems to me not impossible to imagine that Congress will give a different kind of regulatory agency a mandate to encourage the development of therapeutic uses of new biotechnologies before it permits enhancement uses. And there will obviously be a lot of gray areas and argument over what is enhancement and what is therapy. But that seems to me a very

straightforward kind of thing, that the purpose of medicine is to cure sick people; it is not to transform people into gods.

Now, I think that it really does require a very different set of institutions than we have now. Because the FDA and the NIH, which are the two main regulatory bodies in the United States, the FDA has a statutory mandate to regulate only on the basis of safety and efficacy, and it is told to stay out of ethical kinds of issues. The NIH also has a similar limited mandate, and it only has jurisdiction over federally funded research.

If you think about people using a kind of near-term technology like pre-implantation genetic diagnosis to screen for various enhancement characteristics, I would say that you need an agency. And the British actually already have a model of this -- the Human Embryology and Fertilization Agency, which regulates their IVF industry much more strictly than ours is regulated today. A lot of pro-Life people don't like it, because, under the law that created that agency, it permits therapeutic cloning, but it has very strict rules that prohibit biomedical researchers from doing other things with embryos -- for example, experimenting on them past a 14-day period and the like. And so I think there are actually institutional examples out there.

One further thing on the international side is there is no example of a regulatory institution today that is universal,

international and uniform. That is just not the way regulation works. And the problem of getting other countries to agree I think is an important one, at least with regard to the research. But, on the other hand, the point of a lot of social regulation -- for example, a ban on reproductive cloning -- does not depend on its being done somewhere else.

I think the closest analog to the kind of reproductive cloning ban that I would like to see is the current ban on incest. It is interference by the state on an individual's reproductive choices, and the incest ban is supported for complex reasons. Some people support it on the grounds of just safety -- that if you have parents with two recessive genes, you increase the likelihood of birth defects and so forth. Other people are very firmly convinced that there is a moral wrong involved. And those two groups partly overlap and partly don't, but it leads to a social consensus on the necessity for that.

The fact that it is not leakproof or the fact that you can go on a ship and commit incest outside of American legal jurisdiction isn't a reason for not having that ban. And I think the same considerations would apply to something like a cloning ban.

The fact that the Chinese are going to do this if we don't, you know, the Chinese harvest organs from political prisoners and they enacted a very nasty, very crude eugenics law

back in 1995. And so I just don't that the fact that it is done in China is much of an argument why we, therefore, have to get into this race with them to permit these kinds of practices.

DR. STOCK: Let's look at the issue of therapy and enhancement. I think that is a good example, because I think that that is an extremely poor guideline for regulating these technologies. First of all, I think that it is very ambiguous. Let's take an example that does not have to do with reproduction but has to do with anti-aging, medications that would retard the aging process in some way.

Currently today, we spend a fortune trying to roll back serious age-related diseases, like Parkinson's, like Alzheimer's, like heart disease, in ways where we spend a great deal in medicine to buy people an extra short period of time, of really relatively low quality of life. Now, if you were able to develop an intervention that would allow the actual slowing, to retard the aging process itself, to extend the period of longevity, there is no question that that would be an enhancement. Say you could add 10 years or 20 years to a person's life; there is no question that that would be an enhancement. It is something that no humans have ever had before. Yet, at the same time, it would be therapeutic, because it would be dealing with the aging process and all of the age-related diseases that we are targeting so much of an expenditure towards.

Now, as to whether this is going to happen or not, you can argue about that, but there are serious researchers in the field of the biology of aging who think that that is quite plausible and that there will be interventions. There is nobody who believes that there are going to be single genes that are going to be involved, but that there are constellations of genes and various pharmaceuticals and stuff.

Now, it seems to me that in your model you would say that we shouldn't be entering this realm, that this is not the kind of development we want to have. Taking that as a specific example, I would disagree entirely on that. And I think there are very many other examples along the same lines.

DR. FUKUYAMA: The whole question of aging and life extension, I think actually I would probably concede that it is going to be extremely difficult, if this stuff comes on line, to tell people that they cannot have it. I think actually that the presumption that any innovation that prolongs life is therefore, ipso facto, a good thing, either for an individual or for society, is very problematic. And the whole effort to defeat death, it seems to me, is a kind of striving that speaks of a kind of serious lack of a certain kind of moral perspective.

But I think that you are right, that trying to convince people of this, is quite hopeless. And so there will be areas where I think it is going to be very difficult regulate.

I would just point out, in certain ways, we are already living part of this nightmare. You can imagine this kind of national nursing home scenario, where a very large part of the population has been kept alive by earlier innovations in biomedicine that allow the body to survive and other things to deteriorate. You've had this epidemic of Alzheimer's in the last generation simply because people are living long enough that they can get Alzheimer's.

And I think that the general prospect of pushing back human life expectancies is fraught with all sorts of dangers. For example, with no further innovation in biotechnology, Japan, in the year 2025, is going to be in a situation where there are two workers for every retired person. Most of the developed world is facing a very big economic problem having to do with pension liabilities. But it may not stop there. You may, under certain scenarios, get a world in which there is one worker for every three retired people. But that is not a good outcome. That is not a socially good outcome.

DR. STOCK: But despite our differences here, I think we would both agree that these kinds of developments would be very hard to regulate. But I really differ from you in that I hear in your voice that it would be desirable to somehow restrict these things if we could. Now, I am not talking about increasing decrepitude. And nobody really wants that. And there are very

many social consequences to that. And I would agree also about the many problems that we have as a society because of our unwillingness to accept death.

But, at the same time, hypothetically, if there is something that could extend the health span in a significant way, a period of vitality, I believe that not only would people want it, to the extent that you couldn't control it and block it, but that to do so, to even think that you would want to do that, would be against the desires of the public and of individuals and would be something that it shocks me that one would even want to do that.

Third, I think that the actual social consequences might be quite beneficial, in that there have been economists who have looked at our increase in standard of living and have suggested that half of that, since 1900, is as a result of increased longevity and an ability of people to contribute for a longer period of time actively in their lives.

DR. FUKUYAMA: This leads into a very interesting debate of whether that is in fact the case. There are a couple of things. One is just a practical matter. If biomedicine could produce extended longevity, where everything just keeps going gangbusters, you're young and beautiful and sexy up to age 150, and then everything shuts down within a month or so, and then bye-bye, but it has been a great 150 years, well, yes, you're

right, everybody is going to want that, and who is going to be able to stop something like that? But I just ask you to speculate a little bit on the likelihood that that is actually what is going to be delivered to us.

What is going to be delivered is a package of interventions, some of which have higher probabilities. But if they don't all work simultaneously, you pave the way for some fairly gruesome scenarios, where you have 150 years of life but the last 50 may be spent in a nursing home.

DR. STOCK: But they couldn't possibly be more gruesome than the current scenarios, where we have people maintained in vegetative states, where we have people curing heart disease in people who have Alzheimer's. So, I am not talking about some perfect world. I am saying that with this kind of exploration, I see the possibilities here. To turn away from the possibilities, you can pooh-pooh the possibilities, and say, well, it is really going to be problematic, but that will come out in the cards. If those sorts of things don't work out, then fine. But it seems to me that as a goal there is nothing wrong with it. And why would we want to stop that kind of work?

DR. FUKUYAMA: I will give you just one possible answer. Generational succession and the whole reproductive cycle has been something that has been very critical to human identity. The fact that you start out, you're educated, you're socialized,

you have come of age, you become an adult, you have children, and then die. You grow old and you die and you're replaced by someone else. Now, in actual social and political history, the fact that you have generational succession I think has actually been absolutely critical for innovation and progress.

I know that you can say, well, you have invested all of this human capital in educating and training people, and then if they die you simply lose all of that. I would venture to say that if you looked more carefully at that, you would find that a lot of that intellectual capital, at a certain point, becomes obsolete just like other forms of capital. And the thing about obsolete human capital, unlike obsolete physical capital, is you cannot get rid of it.

There is a saying in the economics profession that the discipline of economics makes progress one funeral at a time. And I think that there are very serious questions about how innovation would happen and how people would view that natural cycle of life if three, four, or five generations are all alive simultaneously, where reproduction has then become an extremely small part of any individuals life and you're basically then detached from all of these natural rhythms.

DR. STOCK: It's not useful to discuss whether these would be desirable or not in a larger way. The point I am really trying to make is that, on an individual basis, when I talk with

people about these things, they say, oh, what about the population crisis, the environmental crisis? Well, these are all sorts of problems; would we want this? But put me down on the list.

So, I'm just saying that these kinds of social engineering and making decisions in the abstract about what would be desirable for society as a basis for regulation I think is one that will have to be imposed, and imposed rather harshly. And I think that the kind of regulatory structure which is more appropriate is, for instance, in reproductive choices that parents make. It seems to me that you can look at the interests that society has, you can look at interests that the parents have, and the child. And it is in situations where parents are making choices that are clearly deleterious to their children, that are taking advantage of their future children -- those are the kinds of things that we have to block.

And it seems to me that there are going to be a realm of things that can be done, that everybody would agree is just egregious. And there are going to be things like preventing diseases that everybody will agree is just fine. There is going to be a whole middle ground, like deaf parents selecting to have deaf children, things of that sort, that there is going to be a lot of disagreement about. I think largely, for those things,

safety aside, we should leave them up to individual parents to decide.

DR. MILLER: I suspect you could go two, three or four more hours without repeating any territory. Let me move just briefly, before we go to questions from the audience, off of what essentially has been a consequentialist/utilitarian divide over arguing with these items and get back to a couple of core things that may separate you.

Greg, I think that when you were talking in your book about the key aspect of human nature, you focused upon the ability to manipulate the world in which we live, whereas Frank is talking about human nature and more of a commonality, a core essence. Could you segment them in terms of how you're approaching it differently? Because, fundamentally, we are getting down to beyond just, does this work, is it a little bit safer, a little bit better, what do we fundamentally think we are in this world for?

DR. STOCK: I will lead off, because my vision of what it is of our humanness is that in fact we use technology in all sorts of ways. We shape our environment. What separates us from other animals is in fact our ability to engage in this larger sort of project. And in fact, if you looked at it and said, what is the most natural form of human reproduction, it would probably be in vitro fertilization, using our technology and applying it

to our reproduction. That is highly characteristic of what we do as human beings.

If you look at the completely unaided reproduction, this is much more characteristic of what ties us to the rest of the animal world. And in fact, I think that taking that kind of idea, in a larger way and extending it, is probably what separates my vision from yours.

DR. FUKUYAMA: I would recommend your reading the last chapter of Greg's book, because it has the most far out speculations. But, among other things, he speculates that using this kind of technology, there could be a kind of genetic specialization among different groups of people, so that there will be one group of people that select children for musical ability and others that select for being super athletes and the like. Plus which you have this broad category of people that are enhanced and people that are unenhanced.

In virtually the last thing that Thomas Jefferson ever wrote in his life, his letter to Whiteman that was composed just a couple of weeks before his death in 1824, he said that one of the great accomplishments of the American Revolution had been to enshrine in principle the principle of equality that is based on the natural -- and this is not a religious assumption -- observation that certain people are not born with saddles on their backs and other people are not born booted and spurred.

The achievement of political equality in a country like the United States is based on the de facto observation of natural equality. Blacks and women did not have the right to vote, did not have equal political rights in this country, because at one point in time people believed that they were genetically not suited to exercise that capability. And what we have learned as a result of the defeat of scientific racism and all of these other things in the 20th century is that there is in fact a high degree of genetic equality among people, that the variants between races, for example is much less significant than the variance within races. And this has been one of the great achievements -- to recognize that and to see that there is actually an empirical basis for our political doctrine of equality.

I think that if any of the stuff materializes that Greg talks about in that last chapter, you shoot to hell this principle. Lee Kuan Yew suggested at one point that rich people in Singapore should get two votes and everyone else should get one vote. Well, on what basis, if you have a class of genetically enhanced people, why shouldn't they get two votes instead of the one vote that everyone else gets? What is the grounding in principle, if in fact these people are different by nature, for saying that they shouldn't have a superior class of rights?

DR. MILLER: You are making life very difficult for Roger Pilon and his theory of natural rights. I'm thinking of new versions of the Constitution -- we hold these truths to be self-evident until the next genetic modification. We're endowed by our laboratory with certain artificial rights.

(Laughter.)

DR. MILLER: One follow-up, and then we will go to the audience.

DR. STOCK: One quick follow-up. I think as to that image of some people who are the riders and some are the beasts who have saddles, essentially, implicit in that is not just one of differences, because there are enormous differences in our population today, and, through mate selection, we often extend those differences. There are basketball players who are huge and jockeys who are very small, to take an obvious physical difference, and we are able to deal with those quite effectively.

The thing that will bind people together, I think, is not their similarities or what their values are or what they think is important in life and how they choose to lead their lives, but they are doing so out of free choice, and they are making choices about preferences as they do normally in their lives. They are just extending that into the biological realm in some way. And we already do that with pharmaceuticals, where some people are taking drugs because they would like to be a

little happier or don't want depression. So we do these manipulations in other ways. And I think that riders and horses is an unfair metaphor to use in this kind of a realm.

DR. MILLER: Let's add to this conversation more in terms of your questions and inquiries, and you can keep your commentaries to a private discussion with your clone. Please wait until a microphone comes, and identify yourself.

Sue?

MS. BLEVINS: Sue Blevins, Institute for Health Freedom.

I am curious to know, in the United States today, are there DNA ownership rights? I am talking about the unique component that makes me myself. And if there are not, should there be DNA ownership rights? When you talk about a free choice, would that also include the choice to not share my unique component and to not want to be cloned? I am curious about the law.

DR. STOCK: I'm not certain. There have been a number of cases where there have been issues of commercial development related to drugs and such. It hasn't been uniform in what those decisions are. I think that there is generally a feeling that individuals would have a right to, for instance, prevent someone from taking some cells from them when they shake their hand or when they take their glass and going off and cloning someone with

that genetic constitution. As far as I know, there is no legal structure dealing with that realm now.

Maybe you know more, Frank.

DR. FUKUYAMA: I think it is an area where we need to have some legal structure. Because I think that one class of worries is privacy violations, where people are using your genetic information for various purposes. The other thing is whether it is legitimate for corporations to own the rights to certain human variants. This has already come up in terms of stem cells and the patenting of stem cells and the patenting of particular sequences that are developed as a result of this kind of research. So, that's another area.

We have only touched on, I think, the areas that actually need more rules than we have right now, and I think a more thoughtful discussion of what those rules ought to be needs to take place.

DR. MILLER: Another question from the audience?

MR. MUNROE: Neil Munroe, from National Journal, for Mr. Stock.

You talked about a sense of humanity resting on a common appreciation of free choice. But, insofar as this technology teaches us about how the brain works, how perhaps genetics affect our choice, can the idea of choice survive the development of very sophisticated calculations in a free market,

where companies have an incentive to twist and present the data in various ways?

DR. STOCK: I think this notion of free choice is going to come up in a legal context in a way that is going to be difficult for us. Because where it is going to come up is if you look at a genetic profile and you see a strong predisposition towards a certain type of behavior, people are going to argue that, well, I committed such and such a crime or I did such and such a thing because it was in my genes; I couldn't control myself. We already see that with somebody who watches a music video and will make those sorts of claims.

If you want solid red lines that need to be drawn, I think the idea of holding people accountable for their actions is going to be absolutely essential to maintaining a viable society.

MR. MUNROE: But how can you hold people accountable for your actions if my genetic test shows person A is 30 percent predisposed and person B is 60 percent predisposed, and because of the circumstances and these chemicals, well, it is a 20 percent calculation differential and it depends on the percentages?

DR. STOCK: There are all those percentages, but the reality is that for most of the kinds of aspects of who we are, the balance between the variation in the population that can be explained by genetics varies from about 25 percent to as high as

75 percent. The rest comes from our individual personal experiences. And there is a great deal of room there for talking about a person having some responsibility for the choices that they make. If you assume that this is sort of genetically deterministic, then you run into all sorts of problems. I think that this is going to be a difficult area that will challenge our legal system and our way we think about human motivations.

One follow-up on that is that we are going to deal with this whether we manipulate or whether we intervene or not. Because just the knowledge is going to be very challenging for us in terms of challenging us to deal with the real differences between people and between different populations in an egalitarian society.

DR. MILLER: Yes, another question?

MR. HANSON: I'm Robin Hanson, Department of Economics at George Mason University.

I wanted to ask Professor Fukuyama if he really took these externality arguments seriously or whether they were sort of excuses. So, to probe at that, you talked about the externalities of boys basically being harmful for the world relative to girls, and the externalities of people who live longer being harmful for the rest of us because they live longer.

DR. FUKUYAMA: Potentially.

MR. HANSON: But those externalities are independent of the cause of those factors. So, the economist's response is, if those are real, let's tax all boys and let's tax all people who do things that make them live longer.

DR. MILLER: Or let's have a really big war. That worked in the past.

MR. HANSON: Or tax people who choose not to smoke. There are lots of things people do that make them live longer, so why not tax all of those things and why not tax all boys? Why specifically genetically enhanced boys or genetically enhanced long lives?

DR. FUKUYAMA: That seems to be an awfully round-about way of doing it. Why not just prohibit sex selection? If that is a negative externality, that seems to me a much simpler and more straightforward and fairly non-controversial way of handling the problem than taxing boys.

MR. HANSON: When I'm speaking of negative externality, I'm not saying there should be zero level of the activity; it just means the people's choices need to reflect that extra price that they are imposing on other people, right?

DR. FUKUYAMA: Yes, okay, maybe in theory. I guess it depends on how much you value the ability of people to select the sex of their children. Maybe it would be more sensible to have a tax on boys. I just can't believe that that would actually be a

choice that people would make. Maybe it is the desire to be able to select sex -- which I don't perceive as being highly developed in this country -- but in a country like Korea.

Incidentally, this is an interesting case, because you have cited the inability to change any of this. But in Korea, actually, that ratio has gone back much closer to 50/50 in the late 1990's simply as a result of the Koreans enforcing their existing laws and as a result of this being talked about in the newspapers and the Koreans saying, well, it's a great shame that this is happening. And this is not an authoritarian country that is imposing this; this is a democratic country that, as a result of discussing some of the consequences of these easy forms of reproductive technologies, has actually shifted the ratio back.

DR. STOCK: I would like to add that I don't think that it is not possible to control clinical applications of technologies. I think that, in terms of controlling the kinds of possibilities that will exist is particularly hard -- the technologies themselves are really hard to control.

As far as this boy/girl thing, I think that that is a very interesting issue. Because when we deal at an abstract social level and say, society would be a little bit better off if we had a balance between boys and girls, a male and female gender balance, well, that's true. But when you start getting down to the individual, some people actually care a great deal about the

gender of their child. And for people who don't have a strong feeling about that, then you can say, well, so what; why does it matter what their choices are? For society, it's better off.

But it seems to me that we only should be controlling the details of individual, personal choices that are being made when there are very clearly demonstrated problems that are serious ones for society that emerge. And then we can think of how to deal with them to create incentives or restrictions that prevent those negatives.

DR. MILLER: Before we break for lunch, let me finish with one final question for both of you to bring this down to the nitty-gritty dirty world of politics. We haven't touched on religion. That has been kind of kept out of this. It has been very much a secular discussion. But there is another kind of holy war that goes on among different factions and political groups.

There seems to be a growing divide between what might loosely be labeled conservatives and libertarians on this issue. And we have a whole lot of groups of folks, kind of weird coalitions -- environmentalists, feminists -- and the old formulas for sorting out the iron filings with a magnet don't seem to work here. Is this going to change some of our larger politics? Why do we see these fissures developing?

DR. FUKUYAMA: Absolutely, I think both the left and the right are going to split completely on this issue. On the left you see it more strongly in Europe than you do in this country, because the environmental movement is stronger there. But, clearly, they are on the side of restriction of these forms of technology.

I think you are right that the Republican Party in the United States has been a coalition of social conservatives and economic libertarians and, for the most, they can coexist and live happily with one another. But I think when you get into these technologies, they are absolutely going to split apart. So, I think that politics will look very, very weird when we really start confronting some of these issues.

DR. MILLER: Greg, if the Libertarians clone themselves, can they just outnumber them?

(Laughter.)

DR. STOCK: I don't know. It's possible, if they're very eager about it.

(Laughter.)

DR. STOCK: I think that one of the things that we also observe is that people start off with preconceived notions. For instance, the abortion debate. They take their ideas about abortion and then they alter them in any way that they need to, to try and find support or to insert them into new debates. I

think that that ends up with very troublesome and problematic results.

An example is the issue of the cloning legislation that is currently reaching the Senate. The idea that we would stop reproductive cloning is something that I can see arguments for. I think that it is not a very important issue. In fact, cloning is not a huge problem. But the idea that we could then use the fear of clones in some way to then block research with a strong potential for attacking diseases of aging, like regenerative medicine, Alzheimer's, Parkinson's, and other sorts of diseases, and then call this a respect for human dignity because you ascribe some sense of human personhood to a small speck of cells and allow that to trump research towards individuals who have a network of relationships and are conscious beings, it seems to me that this is actually jarring that people could even seriously make those arguments and that such laws could be passed by the United States Congress in a supposedly secular society.

DR. MILLER: If you have enjoyed this wide-ranging, fascinating, intellectual discussion half as much as I have, then I have enjoyed it twice as much as you.

(Laughter.)

DR. MILLER: Please thank our speakers.

(Applause.)

DR. MILLER: And join us upstairs for some genetically modified food.

(Whereupon, the Cato Institute Book Forum was concluded.)