Normative Theorizing about Genetics

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A response to "On the Very Idea of Genetic Justice: Why Farrelly's Pluralistic Prioritarianism Cannot Tackle Genetic Complexity" by Michele Loi (*CQ* 21(1))

In a recent article in this journal[1] Michele Loi reaches the conclusion that we ought to abandon "the very idea that regulating access to genomics involves an account of genetic justice, that is, an account of what would constitute a fair distribution of genetic endowments, describable as a distinct ideal, independent from the social bases of inequality."[2] This is a conclusion to which I am actually, at least partially, sympathetic. And this may seem surprising given that it is my work on genetic justice that is the main target of criticism in Loi's article.[3] Indeed, Loi takes his conclusion to be a position contrary to my own conclusions on these issues.

I am certainly in agreement with the suggestion that genetic justice ought not to be treated as a *distinct ideal*, *independent* of considerations of the broader demands of social justice. In fact, something like that conclusion is the very conclusion I have argued for in my own work. The lax genetic difference principle (lax GDP),[4] for example, maintains that genetic inequalities (important to the natural primary goods [NPGs]) are to be arranged so that they are to the greatest *reasonable* benefit of the least advantaged. The insertion of the reasonableness clause was an explicit attempt to ensure that the aspiration to mitigate genetic disadvantage was cognizant of other kinds of disadvantage (e.g., social disadvantage) and values (e.g., freedom) that fall under the purview of social justice. Rather than serially ordering a principle of justice (genetic or otherwise), like John Rawls[5] does with his equal basic liberties principle and Norman Daniels[6] does with a principle of access to healthcare (by adding healthcare to Rawls's principle of fair equality of opportunity), the lax GDP is a principle designed to bring the complexities of trade-offs to the fore of our deliberations rather than simply bracketing them. And the central aspiration behind the development of the lax GDP was the desire to expand the frontiers of justice to include the distribution of our genetic potentials for valued phenotypes, like health and intelligence.

Loi takes issue with what he calls the "particularistic" aspect of my pluralistic prioritarianism, the view that I adopt for developing an account of genetic justice. My view is particularistic, claims Loi, in that it involves the weighing of different claims of justice (e.g., the duty to mitigate disease caused by genetics vs. the duty to mitigate disease caused by environment). Loi contrasts this particularistic pluralistic prioritarian approach with "monism," a view he ascribes to Richard Arneson, which maintains that *well-being* is the currency of justice "in the sense that the moral weight of removing genetic or environmental forms of deprivation is established by converting all the relevant factors into a unified

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welfare metrics."[7] The question of which approach, a particularistic approach or a monistic approach, is better equipped to help us tackle the just regulation of new genetic technologies is an interesting and important question. However, to answer this more general question, one would need more details than Loi provides about how the appeal to the vague idea of well-being can help us address these issues.

I myself am skeptical that adopting this monistic approach will be of much help. Arneson's "responsibility catering prioritarianism"(RCP), for example, maintains that "justice requires us to maximize a function of human well-being that gives priority to improving the well-being of those who are badly off and of those who, if badly off, are not substantially responsible for their condition in virtue of their prior conduct."[8] This view only makes sense if we assume a certain, rather simplistic, view of human beings and human misfortune: namely, (1) that it is rather unproblematic to ascribe moral responsibility to human actions and decisions (where misfortune is involved), (2) that society can be conceived of as consisting of two groups of people: those who are badly off and those who are well off, and (3) that justice is exclusively (or primarily) concerned with *maximizing* the well-being of those who are badly off, rather than being (also) concerned with balancing (given limited resources) competing prioritarian duties (helping the socially disadvantaged vs. the genetically disadvantaged) or balancing prioritarian duties against other demands of justice, such as respect for procreative liberty. I doubt that adopting the monistic perspective will really help us identify "all the relevant factors," let alone that these diverse factors can also be combined into a unified welfare metric.

Most contemporary theories of distributive justice are ill equipped to tackle the kinds of concerns that arise once we expand the domain of justice to include the distribution of genetic endowments. One cannot begin from an account of distributive justice that was designed with the distribution of wealth in mind and then simply "add genetics and stir." The genetic revolution requires us to undertake a major reconceptualization of what the demands of justice are. And this means that the fundamental (or first-order) principles or theories we begin with must be open to revision in light of the new empirical discoveries in genetics and human biology.

Genes are special, from the perspective of theorizing about justice, because they (1) have been neglected in our normative theorizing (and thus warrant special attention to redress this neglect so that we are better prepared to fairly regulate new genetic technologies), (2) are unique resources and thus require the normative theorist to develop a skill set that is unique from the skills required for tackling the distribution of external resources like wealth, and (3) play an important role in the development of a wide range of valued phenotypes.

Are Genes Special?

Does the distribution of the fundamental physical and functional units of heredity (i.e., genes) warrant special consideration or attention in an account of distributive justice? Do genes require, for example, that a distinct distributive principle be derived that can help guide our deliberations concerning how to regulate new genetic technologies? I believe a compelling case for answering "yes" to this question will highlight the following three ways in which genes are special.

First, the role genes play in the development of important phenotypes (like health and intelligence) has largely been ignored by theories of distributive justice. Historically this neglect was

unproblematic, as the prospect of genetic intervention seemed mere science fiction. But now these technologies have become a reality. So in one important sense genes are special in that they, unlike the distribution of wealth and income, have been ignored in our normative theorizing. In order to develop a more balanced account of justice, one that gives attention to both the genetic and the environmental factors that influence the natural primary goods, we need to make genes special in our normative theorizing. Without doing this, we are unlikely to redress this deficiency in our theories of justice, and we thus risk jeopardizing a just regulation of genetic technologies. We cannot simply take theories of justice that have been designed with the distribution of wealth and income in mind and add genetics (what I referred to earlier as the "add genetics and stir" approach). Taking human biology seriously will require us to rethink, at a foundational level, what the demands of justice are.

A second reason why genetics are special is that they are what we might call unique resources, and as such they require special attention from normative theorists. The genes we possess are the product of the evolutionary history of life on this planet, and they are an integral part of our biology. Genes are not distributed like wealth and income. The latter are primarily influenced by the political economy of society. The levels and kinds of taxation that a market-based economy implements, for example, will largely determine what the pattern of socioeconomic goods is in a society (e.g., equality or inequality). In the case of natural endowments, the pattern of genetic endowments that arises in any given society will be mostly influenced by (1) the evolutionary history of the human species, (2) the reproductive decisions of the members of the society in question, and (3) environment, as revealed through the recent findings of epigenetics.

But the genetic revolution of the past half a century has now opened the door to the development of novel strategies for influencing the distribution of genetic endowments, strategies that may come to mitigate, perhaps even outweigh, the influence of (1), (2), and (3). The prospect of gene therapy and new pharmaceuticals that mimic specific genetic mutations means that the genetic constitutions of persons might be modified in ways that redress the vulnerabilities of our evolutionary history. And new screening and testing technologies can permit parents to screen embryos, fetuses, and potential reproductive partners for risk of genetic disorders.

To understand how the pattern of genetic constitutions we find in any given society, at any given time, first arose, we must adopt the lens of evolutionary biology. So genetics requires the normative theorist to *broaden the intellectual terrain* on which he or she relies for deriving a theory (and the principles) of justice. John Rawls, for example, derives his difference principle—which maintains that socioeconomic inequalities must be arranged so that they are to the greatest benefit of the least advantaged—by relying on insights from economics (e.g., incentives and the concept of Pareto optimality). But deriving a principle of genetic justice will require the theorist to consider insights from epidemiology, evolutionary biology, biodemography (the scientific study of common age patterns and causes of death in sexually reproducing species), and so on. Thus genetic justice is unique or special in that it requires the normative theorist to develop *novel* or *special* skills. A theory of justice equipped to tackle the insights of human biology and the development of novel health innovations will be much more interdisciplinary than a theory designed to tackle

the distribution of what Rawls calls the "social primary goods"—rights and liberties, powers and opportunities, income and wealth, and self-respect.

Because genes are unique resources, they raise unique challenges for normative theorists. Egalitarian or prioritarian aspirations, for example, that seek to redistribute wealth from the affluent to the vulnerable will need to be reconceptualized when transposed to the terrain of genetic justice. Mitigating genetic disadvantage is not achieved by taking the genes of those with more fortunate endowments and giving some of them to those less fortunate. And so the concept of redistribution, which is central to theories of distributive justice designed to tackle socioeconomic concerns, will need to be modified (or perhaps even abandoned) when justice is expanded to include the demands of genetic justice. The importance of scientific innovation, and the fair diffusion of the benefits of scientific advances,[9] is more likely to become central to theories of justice equipped to tackle the challenges of the twenty-first century.

This leads to the third, and perhaps most important and obvious, reason why genes are special—they can have a profound impact on our life prospects. Inheriting the gene for a single-gene disorder, for example, can severely limit the expected lifetime acquisition of health and intelligence. If you are born with infantile Tay-Sachs, you will most likely die by five years of age. If you are born with a mutation of the FMR1 gene and develop fragile X syndrome, you may develop learning disabilities or even suffer mental impairment. So the genes you inherit can increase your risk of disease, disability, and death.

Some people actually inherit genes that make it possible for them to enjoy significantly more years of health than the average person. Recent studies of centenarians and supercentenarians (those who live to 110 years or more) and the impact of "longevity genes" suggests that there is a significant genetic component at play in healthy aging. Having a centenarian sibling increases one's chances of survival to very old age.[10] Furthermore, one recent study found that the offspring of long-lived parents had significantly lower prevalence of hypertension (by 23%), diabetes mellitus (by 50%), heart attacks (by 60%), and strokes (no events reported) than several age-matched control groups.[11]

Genetics also play an important role in the development of behavioral characteristics. Addictions are among the most heritable of psychiatric disorders. Approximately 40 to 60 percent of the risk of developing heavy drinking behaviors or alcohol dependence can be attributed to genetic factors.[12] Genetics also play an important role in intelligence,[13] impulsive aggression,[14] political participation,[15] and even (male) success as a spouse.[16]

Our understanding of the role genetics play in the development of complex phenotypes is still in its infancy. However, the findings of the past three decades or so have made it clear that the fundamental physical and functional units of heredity play a significant role in the development of a wide array of important phenotypes. And for that reason alone, genetics ought to be considered special. The distribution of natural endowments ought to receive at least the same amount of concern and attention that theories of distributive justice place on the distribution of wealth and income. The latter have certainly been accorded special status in theories of distributive justice.

Given the impact our genes can have on an individual's ability to acquire health, vigor, intelligence, and imagination, is the theorist warranted in pondering what the demands of *genetic justice* are? I believe the answer is "yes." And

an important part of the rationale for wanting to do so is that we need to transcend the current imaginative limitations of our theories of distributive justice. Such theories only focus on the distribution of things *external* to us, like wealth and income and opportunities for education. They ignore the distribution of those resources (like our genes) that are internal to our biology and can play a significant role in our acquisition of natural (as well as social) primary goods.

So, to summarize the points noted in this section, I believe genes are special, from the perspective of a theory of justice, because they (1) have been neglected in our normative theorizing (and thus warrant special attention in order to negate this neglect, especially given the pace of the scientific advances of the past few decades); (2) are unique resources and thus require the normative theorist to develop a skill set that is very different from the skills required for tackling the distribution of external resources like wealth; and (3) play an important role in the development of a wide range of valued phenotypes.

Response to Loi

In terms of responding to some more specific issues that arise in Loi's critique of my work, I wish to first break down Loi's general conclusion into some more distinct claims, to help clarify the general areas of our agreement and disagreement. Let us distinguish between the two following claims:

1) We do not need an account of what would constitute a fair distribution of genetic endowments.
2) We do not need an account of what would constitute a fair distribution of genetic endowments, understood as an ideal distinct from the other demands of social justice (e.g., equality).

I have some sympathy with (1), but I am unconvinced that it is a better strategy to pursue. Are we likely to determine what constitutes "well-ordered science"[17] by simply taking the principles and conclusions of theories of distributive justice that (a) are designed to regulate the distribution of socioeconomic goods and that (b) ignore the realities of human biology? I think not. What will tend to happen is that the moral sensibilities fashioned in the context of a discussion of wealth and income (like equality or priority) will be transposed to the site of genetic justice. And this will result in unsound practical prescriptions rather than the kind of all-things-considered judgments required by social justice. I believe that the latter is more likely to be realized when genetics are considered special in the way, and for the reasons, outlined in the previous section.

As for (2), I actually agree with this statement. I do not believe that principles of genetic justice, like the lax GDP, are to be understood as an ideal *distinct* from the more general demands of justice. The lax GDP attempts to integrate the duty to mitigate genetic disadvantage within the broader demands of prioritarianism and social justice more generally. It does this by aspiring to balance competing prioritarian demands (e.g., helping those who require direct genetic intervention and those who require other forms of assistance) and by trying to balance prioritarian duties with the other duties (e.g., respect for liberty) of justice. Loi objects with his example of a genetic predisposition to drug addiction. More specifically, he believes my pluralistic prioritarian approach cannot justify helping those who are members of what he calls the "sociogenetic" group with the lowest expectations of natural primary goods.

The example Loi utilizes is, he acknowledges, hypothetical. He imagines a scenario in which a genetic predisposition

that makes it difficult to overcome drug addiction is spread uniformly across different social groups, such that 80 percent of the people with this genotype have, for social reasons, little chance of developing an addiction to begin with. However, 20 percent of the population with this genetic predisposition belong to a socially disadvantaged group with a higher risk of drug use. Loi believes that my lax GDP cannot justify a policy that makes gene therapy for addiction available to these people, because the cause of the disadvantage is a disadvantageous social background, rather than a disadvantageous genetic constitution.

There are a few points I would like to say in response to this objection. First, when I proposed identifying the genetically "least advantaged" as "those individuals whose genetic constitutions place them below half of the median for the expected lifetime acquisition of natural primary goods,"[18] I had included a footnote (note number 17), which read as follows: "The genetically least advantaged are a *subset* of the more general category of individuals who are least advantaged in terms of their expected lifetime acquisition of natural primary goods. Other members of this category include those in serious accidents and those who fare poorly in terms of the acquisition of social primary goods (e.g., the malnourished)." I inserted this footnote to fend off precisely the kind of objection Loi is making—namely, that a principle of genetic justice cannot adequately identify all members of the least advantaged. But it is not intended to do this. It is meant to identify those who, because of their genetic constitutions, may be members of the larger category of individuals considered the least advantaged.

Most, although perhaps not all, of the genetically least advantaged (defined as having below half of the median for the expected lifetime acquisition of natural primary goods) will be those with severe single-gene disorders who, regardless of the socioeconomic position of the family they are born into, will be severely disadvantaged with respect to their expected acquisition of natural primary goods. Males with fragile X syndrome, for example, have an IQ of about 40.[19] For females the disorder is typically milder. But males with such a low IQ would certainly qualify as members of the genetically least advantaged. Their expected lifetime acquisition of intelligence and wealth and income would fall below half the median expected levels. The same is true of children born with cystic fibrosis, who, in the United States, have a median predicted age of survival in the mid-thirties.[20] One could also include individuals who inherit genes for early-onset cancer and so on. Most of these individuals would develop their conditions and disorders regardless of the socioeconomic position of their family.

The genetically least advantaged might also include those whose genetic constitutions put them at a high risk of multifactorial disorders—like cancer, (type 2) diabetes, dementia, and so on. Now, these are more problematic cases, because they are typically *late*-onset conditions. So would we consider a smoker who dies at age 65, because he or she smoked and also possessed the genes associated with nicotine dependence and lung cancer,[21] among the genetically least advantaged? Did this genetic predisposition result in him or her receiving *less than half the median* in terms of health, vigor, intelligence, and imagination? It seems unlikely that death a decade before the average would satisfy the definition of the least advantaged in this case.

Furthermore, although it is certainly true that socioeconomic considerations like wealth and income do influence one's risk of multifactorial diseases and disorders, it is not the case that the

affluent and educated are *immune* from these conditions. Far from it. Affluent, educated individuals can have their lives cut short because they develop cancer, heart disease, stroke, and so on. Faring well in the social lottery of life does not necessarily mean that one fares well in the natural lottery of life.

The lax GDP principle instructs us to consider how we can fairly balance competing prioritarian demands, so that we do not fetishize the aspiration to directly mitigate genetic disadvantage over other kinds of interventions (like mitigating social disadvantage). So in the case Loi describes with respect to addiction, the lax GDP might actually prescribe that the best solution is to tackle the environmental conditions (like poverty) that make drug use a real risk rather than simply seeking to alter the genetic predisposition to addiction. If the former was a more cost-effective intervention, for example, then it would be advisable to pursue that strategy instead of gene therapy. The lax GDP only requires us to justify the policy options to the genetically least advantaged. Thus the response, "The expected lifetime acquisition of NPGs of the least advantaged would be higher if society spent more on tackling poverty than providing gene therapy for addiction" is one that could pass the test required by the lax GDP.

Tolerating a genetic inequality in predisposition to drug addiction could be justified to the genetically disadvantaged if their interests (in addition to the interests of other disadvantaged persons) would be better served by tackling environmental, rather than genetic, risks. The lax GDP does not rule out such prospects. If the principle is conceived, as Loi seems to presuppose I must, as an ideal distinct from the broader demands of social justice, then that might be the case. But I do not see why I am committed to that position. Indeed, by arguing that genetic justice must track genetic complexity, I argue for the opposite conclusion- that genetic justice must be cognizant of the more general demands of social justice.

Furthermore, Loi's contention that the application of the lax GDP fails to provide proper guidance in his example rests, in part, on the artificial constraints of his hypothetical example. Drug addiction can seriously limit the expected lifetime acquisition of NPGs of those born into favorable (as well as unfavorable) socioeconomic situations. In other words, addiction (to alcohol, cocaine, heroin, etc.) does not only afflict the poor. A 2005 national survey on drug use in the United States found that, although illicit drug use was associated with educational status, this did not mean individuals from more privileged backgrounds did not use drugs. The rate of illicit drug use among college graduates, for example, was 5 percent. For those who did not graduate from high school it was 9.8 percent, and the rate for high school graduates was 8.6 percent.[22]

The report also notes that, among the college-aged population (persons aged 18 to 22), the rate of drug use is the *same* for full-time college students (21%) and for other persons aged 18 to 22 years. So a person's age has a profound impact on the likelihood of using drugs, and this risk transcends educational status. College students are more likely to binge drink and drink heavily than their cohorts who are not in college, although they are less likely to smoke cigarettes. Young adults across the socioeconomic spectrum are much more likely to use illicit drugs. So the story of the risk of addiction is much more complex than Loi's example presupposes (i.e., that the poor have higher risks than the rich).

One last point to note that illustrates how the issue of drug use and addiction is much more complex than Loi presumes is to consider how *gender* influences the risk of use of illicit drugs.

Males report a much higher use of illicit drugs than females (10% vs. 6%, respectively). This means that males, as a group, have a higher likelihood of reporting use of illicit drugs than the group of persons who do not graduate from high school! This can be contrasted with the situation of females, as a group. The likelihood of females reporting use of illicit drugs is closest to the rate reported for college graduates. So gender and age are extremely important factors, and one could persuasively argue that they are more important factors than affluence and education when it comes to the likelihood of using illicit drugs. Indeed, the vulnerabilities of being male are grossly ignored by *all* the prominent theories of justice that I know of. And yet "being male is now the single largest demographic risk factor for early mortality in developed countries."[23] An account of genetic justice that takes seriously the different life history strategies of males and females is much more likely to bring the biological differences and inequalities between males and females to the fore.

With a more accurate picture of the story of drug addiction now in hand, one might contend that a genetic predisposition toward addiction, if the risk and harm in question is serious enough, *already* places a person among the category of the genetically disadvantaged (perhaps even among the least advantaged), even if he or she is not necessarily born into a socially disadvantageous home. Children born into rich families take drugs, some become addicted, some then become poor as a result of drug addiction, and some even die from their drug use. So another appealing feature of applying something like the lax GDP is that it compels us to consider the complex interplay between genes and environment. That is why I believe it is important for theorists to develop an account of genetic justice. We are more likely to make sage decisions about the just regulation of genetic technologies if our principles and theories track the complex empirical realities of our biology.

Another example Loi addresses to highlight what he takes to be the deficiencies of the lax GDP concerns interactive predispositions. He constructs an example for genes and IQ to illustrate this point. He imagines a scenario in which everyone in society is genetically identical except for two genes that confer an interactive predisposition with an inversion of rank: gene P is a predictor of higher IQ in poor learning environments and gene R is a predictor of higher IQ in rich learning environments. He further imagines that these two genes are roughly equally distributed among the population. Furthermore, parents can buy gene R from an unregulated "genetic supermarket."

Loi then stipulates some further conditions, in order to illustrate what he believes is the problem with my approach to genetic justice. In one scenario,[24] 50 percent of children enjoy a rich educational environment. In this case, the lax GDP cannot single out P or R as, all things considered, better genes in terms of expectations for acquiring the natural primary goods. This is so because possessing either gene will not be correlated with higher levels of NPGs. But in this kind of scenario, the socially advantaged can purchase gene R, and, because the rich can predict their children will receive a rich learning environment, they achieve more intelligence.

Furthermore, and I have to admit this assumption stretches what I believe was an already overstretched hypothetical example, Loi tells us that we are to also assume that the members of this group of "enhanced" individuals undertake careers in art, philosophy, and social science. These careers, states Loi, have intrinsic merits but cause little, if any (!),

trickle-down effects in terms of promoting the social and natural primary goods of others. However, I must interject at this stage of Loi's example to note that his claim that the arts, for example, can have no impact on the imagination of the socially disadvantageous is simply puzzling (do the socially disadvantageous not read literature, listen to music, watch cinema, etc.?). When conjoined with Loi's assumption that all individuals "enhanced" with gene R would enter the same type of careers, I have to admit that I think the example no longer warrants serious consideration. But let us persist with the example, to see where Loi takes things.

Loi believes that the scenario he has described is problematic for the lax GDP because the principle could not sanction prohibiting the genetic supermarket for gene R, because, although it affects the distribution of expected NPGs across differently advantaged social classes, it does not affect the distribution of NPGs among differently advantaged genetic classes. Furthermore, Loi believes the lax GDP could not justify a tax-subsidy scheme in which the taxes on the genetic enhancement could be used to improve the education of the socially disadvantaged. This follows, argues Loi, because of two things: (1) such a redistributive policy cannot be said to improve the expectations of the genetically worst off and (2) principles of genetic justice are not intended for educational policy.

I have many different kinds of responses I would like to make to Loi's example. First, I am inclined to concede the point that one could imagine a scenario in which the lax GDP yields problematic or ineffective results. However, the more contrived and implausible the example invoked, the less troubled I am by it. And I take an example that presupposes that (1) everyone is genetically identical except with respect to genes for IQ, (2) there might be a single gene for intelligence (which is a complex trait and encompasses a variety of general and specific abilities), (3) we could describe a society in which children receive only one of two kinds of educational environments (rich and poor), and (4) those who receive a genetic enhancement for IQ and are born into rich environments go on to pursue careers that have no benefits (on the social or natural primary goods) for the socially disadvantaged is a contrived and implausible example. What would trouble me is if Loi invoked a plausible example to reveal the deficiencies of the lax GDP. Absent such an example, I believe his critique fails to be persuasive.

My second response is that the contrived example Loi constructs illustrates a point I raised earlier. It is apparent that what really underpins the example Loi constructs is his concern that justice may require placing limits on genetic enhancements that exacerbate inequalities in intelligence. It is hard to imagine what else would motivate one to construct the kind of example Loi imagines. So Loi approaches the topic of regulating genetic technologies from an already preestablished ideal of justice (which I suspect is an egalitarian one). The conclusion the egalitarian wants to arrive at is that the rich should not be permitted to purchase genetic technologies that will exacerbate inequalities between the rich and poor. And so Loi goes to great lengths to describe a scenario in which this would happen and concludes that the lax GDP should be dispensed with because it does not yield that very conclusion.

But let us invoke the lax GDP in the case he describes to see if it can in fact help us think about what ought to be done in this scenario. Genetic inequalities for the NPGs must be justified to the genetically least advantaged. And so we envision the victims of Tay-Sachs disease, fragile X, inheritable early-onset cancer, and so on as being present at the

deliberation table for regulating a genetic enhancement for intelligence. Would they be demanding that a prohibition be placed on such a technology? I do not believe they would. They would agree that intelligence is a greatly valued phenotype and that parents have a legitimate interest in promoting the intelligence of their children. They would also concede (contrary to the stipulation that Loi imposes on the example) that the socially and genetically disadvantaged would benefit from a society with more intelligent citizens.

Such "enhanced" citizens might make sounder political decisions when choosing political representatives, or determining which policy issues really matter. More intelligent citizens could make important advances in science and medicine; perhaps one of these enhanced children will one day discover the cure for a disease that afflicts the genetically least advantaged. Even if the chances of the latter are small, it would be reasonable to assume that permitting (rather than prohibiting) scientific advances with a genetic intervention for intelligence would confer *some* benefits on other areas of scientific inquiry, including research into the development of therapies for individuals suffering cognitive impairment.

More intelligent citizens, even if they all chose careers in the arts, philosophy, and social sciences (!), could benefit the intelligence and imagination of the socially disadvantaged. So there is no reasonable basis for the genetically least advantaged to prohibit a genetic enhancement for intelligence. Such a technology would not worsen their own situation. In fact, such a technology could benefit the genetically least advantaged as well as many other disadvantaged groups (e.g., the socially disadvantaged).

I believe the reaction of the genetically least advantaged would be different if the policy in question was state funding for a genetic enhancement for intelligence. So if the government was proposing to spend the bulk of medical funding on pursuing experiments for enhancing intelligence while cutting funding to gene therapies for severe, early-onset diseases, then things would be different. But that is not the scenario Loi envisions.

But suppose, for the sake of argument, that we believe the genetically least advantaged would object to permitting the enhancing technology in Loi's scenario. Perhaps the genetically least advantaged believe it is unjust to allow some citizens to enjoy more intelligence when they themselves will die prematurely from disease. (In which case they might also object to permitting rich learning environments or learning of any kind!) So we then propose adopting the second policy Loi mentions, which permits the genetic enhancement but taxes it and uses those funds to help the socially disadvantaged. Can the genetically least advantaged reasonably reject such a policy? The policy may exacerbate genetic inequalities, but by doing so it will help mitigate social inequality. Would it be reasonable for the genetically disadvantaged to insist that we forfeit benefits to the socially disadvantaged? No. The genetically least advantaged might insist that a portion of the taxes should also be spent on helping to fund medical research on gene therapies that will help them (if this research is underfunded). But it would be unreasonable for them to insist that no weight at all should be placed on the interests of improving the life prospects of the socially disadvantaged.

Contrary to Loi, I believe the lax GDP can help us deliberate about the kinds of scenarios he envisions. Granted, the principle will not always yield the results the committed egalitarian might envision in contrived hypothetical examples, but that is not the standard by which the viability of a principle ought to be tested. Furthermore, the kinds of implausible

examples Loi does invoke reveal what I believe are the dangers of his conclusion. Recall his main conclusion, which is that we ought to abandon the very idea that regulating access to genomics involves an account of genetic justice. Rather than begin our normative theorizing with an *empirically sound* understanding of human genetics, which I believe devising an account of genetic justice compels a theorist to do, eschewing genetic justice means one is more likely to invoke unrealistic examples that cohere with the theorist's abstract normative ideals.

Most egalitarians, for example, perceive the world and society through the bifocal lens of the "haves" and the "have-nots." And all of Loi's examples presuppose this simplistic picture—for example, we are to suppose that the poor, but not the rich, face a real risk of addiction and that the rich can provide rich educational environments and genetic enhancements to their children while the poor are left with poor educational environments and cannot afford genetic enhancements. Although such simplistic scenarios can make things easier for the theorist (in terms of testing the viability of principles), they often do not map onto reality. Where, for example, do the members of the middle class (the majority of people in society) fit in such scenarios? Would the price of genetic enhancements, like other interventions that can impact cognitive development (e.g., access to food, books, computers, etc.), not fall in price so that the less affluent could, eventually, also enjoy these benefits? Where does a factor like age, which cuts across socioeconomic factors and is very relevant when considering the risk of trying illicit drugs, figure in the story? Indeed, the role age plays in our susceptibility to chronic disease has had a profound impact on my own thoughts about genetic justice and led me to the conclusion that the aspiration to retard human aging ought to be among the greatest medical priorities of the twenty-first century.[25]

I believe the lax GDP would be successful when applied to the real-life cases of advances in genetic technologies. The principle can help us distinguish between the different demands that arise with redressing single-gene versus multifactorial disorders, early- versus late-onset disorders, and rare versus more prevalent conditions. Granted, the principle does not provide simple solutions in terms of the complex policy issues that arise with regulating genetic technologies. But what it does do is help *enhance our deliberations* concerning what constitutes a just regulation of genetic technologies. It does this by bringing to the fore prioritarian sensibilities (concerning our biological vulnerabilities) in a balanced and realistic fashion, recognizing that there are many forms of disadvantage, many possible ways to redress them, limited resources, and other important values and interests to consider.

Genetic justice is, in my view, only one dimension (although an important and neglected dimension) of social justice. Genetic justice is thus best conceived of as a subset of the more general demands of social justice. The latter encompasses the distribution of many things beyond our genetic endowments, like wealth and income, rights and freedoms, opportunities for education, and so on. And the real challenge I believe we (i.e., bioethicists and political philosophers) face is determining where the demands of genetic justice figure in the larger picture of distributive justice. And that concern has dominated much of my research for the past decade.

Notes

1. Loi M. On the very idea of genetic justice: Why Farrelly's pluralistic prioritarianism cannot tackle genetic complexity. *Cambridge Quarterly of Healthcare Ethics* 2012;21(1):64–77.

2. See note 2, Loi 2012, at 75.
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4. See note 3, Farrelly 2004.
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9. See, for example, Buchanan A, Cole T, Keohane RO. Justice in the diffusion of innovation. *Journal of Political Philosophy* 2011; 19(3):306–32.
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24. Loi constructs a second scenario, but, because of space limitations, I limit my response to this first scenario. Much of what I say about the first example would also apply to his second scenario.
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