GENETICS, JUSTICE AND FUTURE GENERATIONS

by

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Abstract

How does the distribution of genetic technologies within the current generation influence the potential interests and well-being of future generations? This is the main inquiry of my thesis, which, in order to be adequately answered, is accompanied by a host of subsequent questions, such as: (i) who are the future generations?; (ii) which types of genetic procedures are, in themselves, morally problematic?; (iii) which types of genetic procedures are morally problematic for the generations to come?; (iv) how can these latter genetic technologies affect future generations?; (v) how can these latter genetic technologies affect the social environment in which the future generations will live?

I argue that future generations constitute only a subtype of the large category of future people, and I provide a set of characteristics that could help us define them. I claim that germline interventions aimed at modifying the genomes of future people cannot be morally justifiable if there is no possibility of controlling the intervention either by reversing or altering it, whenever need demands it. Performing germline modifications on currently living individuals targets future generations' health and the well-being associated to it by reducing the diversity of the human gene pool. I provide a definition of enhancement that does not only capture the core of the concept itself, but it also distinguishes it from treatment and prevention. I identify four main areas in which genetic enhancement may come to influence the lives of the future people: (i) collective action problems; (ii) impact on global risks; (iii) utopic singularity; (iv) social configuration. As far as social justice is concerned, I propose allocating enhancing vouchers to all the members of a society, including children and the yet unborn. By looking at the effects of individual enhancements on the larger

social group, I recommend the subsidization of those procedures that bring the greatest collective gains. I emphasize the importance of the environment as a precursor for the materialization of the goals of genetic enhancements. Finally, I argue that epigenetics and one's lifestyle do not constitute adequate topics for a theory of justice - distributive or intergenerational -, but they do represent a fertile ground for ethical scrutiny.

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INTRODUCTION

I don't see how he can ever finish,
if he doesn't begin.
(L. Carroll)

Genetic technologies raise numerous questions. Some of them are specifically addressed to scientists, others to social scientists and philosophers, while still others capture the interest of both groups. As the field is evolving at a rapid pace, the application and safety of genetic interventions, as well as their distribution and moral permissibility are put under increased scrutiny. The aim of this thesis is to explore the distributive component of genetic technologies among current generations and its consequences on future generations and their interests. Discussions of distribution will necessarily lead to considerations regarding application, safety and moral justification, as the latter are tightly connected to the issue of the currency or object of the distribution.

The central question of my inquiry can be briefly formulated as follows: *How does the distribution of genetic interventions among the present generation affect the interests of future generations?* It basically represents a bridge that links together two independent, self-standing areas, each of them of great significance on its own: genetic justice, on the one hand, and the problem of future generations, on the other. I will situate my own research in the existing literature by providing a brief overview of these fields in the next two sections. Before that, however, I need to spell out the main assumption

behind this thesis: 'there will still be a world five hundred years from now and […] it will contain human beings that are very much like us.'[1]

1. Review of the literature on future generations

There are three types of future persons: fetuses, unborn individuals of a family line and future generations. As I will later show in the thesis, the concept of future generations should be strictly demarcated from the two other categories of future people, as they differ in terms of their identity, interests, moral and legal characteristics. Even if, in practice, the three may overlap, in theory, they are distinct. Unfortunately, many times the notion of future generations stands as an umbrella concept that gathers all other types of future individuals.

Most discussions about future generations in philosophy, political theory and bioethics start from one basic assumption: everything we do or fail to do in the present has a consequence on what is going to happen in the future. This idea has been very well captured by Parfit and his Non-Identity Problem, which stresses the fact that current people can affect both the identity and the number of the individuals existing in the future. In spite of this complication that seems to deny the existence of any obligations toward the unborn, it is intuitively hard not to acknowledge the fact that there are connections between generations that give birth to benefits and burdens whose distribution is a matter of justice.

Normative inquiries of intergenerational justice can be traced back to Rawls, who is the first moral philosopher to engage in a thorough discussion concerning the duties of present individuals toward the future. At the core of his conception lies the principle of just savings, according to which the duties that the current generation has toward the future ones is to provide them with 'the

[1] Joel Feinberg, "The Rights of Animals and Unborn Generations" in *Philosophy and Environmental Crisis,* edited by William T. Blackstone (Athens, GA: University of Georgia Press, 1974): 43.

conditions needed to establish and to preserve a just basic structure over time."[2] In order to achieve this, the individual in the original position is perceived as a head of family who does not take into account only his own well-being, but also that of his children and grandchildren. Rawls calls this condition 'the motivational assumption' and it rests on the idea that there is a natural motive that makes humans care for their offspring.[3]

One of the problems with Rawls's framework is that it does not apply to the future generations themselves, but to the unborn children of already existing families. His attempt is to ground the duties that each generation has toward the future in the duties that parents have toward their children. If every person had children, then it wouldn't be logically impossible to safeguard the interests of the future generations by protecting those of offspring. Nonetheless and in fairness to Rawls's account, it is important to emphasize that when he talks about the goods that current people want to secure for the future, he has does not have in mind benefits that are linked to membership in a certain family, but goods that any member of a political community would wish to enjoy: just institutions. As such, because the beneficiaries need not have any specific characteristics – except for being future persons – in order to enjoy the goods, they can be future generations. However, this account cannot explain why childless individuals should care about future generations and this renders it incomplete.

While the contractualist position toward intergenerational justice is represented by Rawls, Gauthier embraces a contractarian framework in order to devise a structure of cooperation and distribution of burdens and benefits between generations.[4] According to him, there is a collective action problem at the intragenerational level regarding the cooperation or defection of present individuals in matters that affect future people. He proposes to solve the problem by

[2] John Rawls, *Justice as Fairness* (Cambridge, Mass.: Harvard University Press, 2001): 159.
[3] J. Rawls, op. cit., pp. 128-129.
[4] Please see D. Gauthier, *Morals by Agreement* (Oxford: Oxford University Press, 1986).

employing a chain of cooperation among overlapping generations, which would create 'indirect cooperative links extending throughout history.'[5] The rationale behind his cooperative strategy is the following:

> Each person, in considering the terms on which he is to cooperate with those in an earlier generation than himself, must keep in mind his need to establish similar terms with those of a later generation, who in turn must keep in mind their need to cooperate with members of a yet later generation, and so on.[6]

Applications of intergenerational justice with an emphasis on the interests of future generations were successfully developed in the field on environmental studies. Issues such as climate change, natural resource conservation, overpopulation, genetically modified crops lay at the center of heated debates focused on the interests of future generations and the duties of the present one. In order to give some answers to these problems, philosophers dealing with environmental ethics and intergenerational justice frequently employ concepts and methods from other disciplines. For instance, in order to evaluate the costs and benefits in between generations, John Broome[7], Thomas Schelling[8], Tyler Cowen, Derek Parfit[9] and Simon Caney[10] discuss the way in which economists make use of the social discount rate in intergenerational and how this can affect the fairness of the relation between generations. On the other hand, Edith Brown Weiss makes use of the principle of equity in order to transform the environmental claims of future people into rights recognized by the international law.[11] An influential writing dealing with the problem of overpopulation, Hardin's *Tragedy of the Commons*[12], relies on game theory as a methodological tool

[5] D. Gauthier, op. cit., p. 299.
[6] D. Gauthier, op. cit., p. 299.
[7] Please see John Broome, "The Ethics of Climate Change", *Scientific American* (2008): 97-102.
[8] Please see Thomas C. Schelling, "Intergenerational Discounting", *Energy Policy* 23: 4/5 (1995): 395-401.
[9] Please see Tyler Cowen and Derek Parfit, "Against the Social Discount Rate" in Peter Laslett and James S. Fishkin (eds.), *Justice between Age Groups and Generations* (New Haven: Yale University Press, 1992): 144-161.
[10] Please see Simon Caney, "Climate Change and the Future: Discounting for Time, Wealth, and Risk", *Journal of Social Philosophy* 40:2 (2009): 163-183.
[11] Please see Edith Brown Weiss, *In Fairness to Future Generations: International Law, Common Patrimony, and Intergenerational Equity* (Tokyo, Japan: United Nations University, 1992).
[12] Please see G. Hardin, "The Tragedy of the Commons", *Science* 162, 3859 (1968): 1243-48.

while approaching the issue of humans' procreative freedom and of its implications for resource depletion. Lastly, Stephen Gardiner discusses the correct interpretation of the Precautionary Principle and the reasons for which it should be applied to climate change policies.[13]

Fiscal policy is another area that has been discussed in relation to its consequences for future generations. Neil Buchanan argues that future people will most likely be richer than we are and that we are doing too much in terms of guaranteeing long-term economic growth. Instead of this, we could focus on the unequal distribution of income and wealth in the current population so that we can be able to avoid fiscal crises and to maintain stability.[14]

Future generations raise serious concerns in the field of constitutionalism as well. The drafting of a constitution represents the work, ideas and values of a single generation, while constitutional provisions and their effects exceed the time span of the founders. The citizens that are to come after the drafting generation are expected to comply with the demands of the past and to lead their lives within the framework set up for them by their predecessors. These considerations represent the foundation of the paradox of the preferred generation.[15] The paradox can be explained as follows. There needs to be a creator of the constitution who ought to offer stability to its community both in space and in time. However, precisely because the founder aims for stability, it threatens the position of the generations to come by binding them to its will. Briefly put, if we have a constitution, we have a generation zero, which is transformed into a preferred generation. Thus, wherever there is a constitution, there is a preferred generation.

The paradox of the preferred generation is tightly linked to the issue of constitutional precommitment, which is also centered on the relation between different generations. The views on

[13] Please see Stephen M. Gardiner, "A Core Precautionary Principle", *Journal of Political Philosophy* 14:1 (2006): 33-60.
[14] Neil Buchanan, "Government Finances Today and Economic Prosperity Tomorrow: What Do We Owe Future Generations?", *George Washington Law Review* 1237 (2009).
[15] Andras Sajo, "Preferred Generations: A Paradox of Restoration Constitutions", *Cardozo Law Review* 847 (1992-1993): 847-863.

constitutional precommitment vary. Some argue in its favor, such as Madison[16] and Elster[17]. Others oppose it, like Paine[18] and Jefferson[19], who stress the fact that individuals have the right to rule themselves.

To sum up this section, the fields that bring into discussion the interests of future generations are: normative theory through its focus on intergenerational justice, environmental studies, economics, public policy, law and legal studies. It is sometimes considered that applications of the Non-Identity Problem link genetics to future generations. Such examples could be found, for instance, in the edited volume of Melinda Roberts and David Wasserman, *Harming Future Persons: Ethics, Genetics and the Nonidentity Problem*[20] or in Walter Glannon's *Genes and Future People*[21]. In spite of their obvious merits, these writings address the topic of genetics from the perspective of two types of future persons, namely, fetuses and the unborn children of a family line, without properly touching the issue of future generations.

Let us now turn to the second component of my topic, genetic justice, and to the literature dedicated to it.

2. Review of the literature on genetic justice

Discussions related to genetic justice emerged with the possibility of altering our genomes, which rendered the distribution of genes an issue of distributive justice. Distributive justice deals with two types of inequalities: social and natural. Until quite recently, it has been generally perceived

[16] Please see James Madison, *The Federalist Papers*, edited by Clinton Rossiter (New York, New American Library, 1961), no. 49.
[17] Please see Jon Elster, *Ulysses Unbound: Studies in Rationality, Precommitment, and Constraints* (Cambridge, Cambridge University Press, 2000).
[18] Please see Thomas Paine, "The Rights of Man", *The Life and Major Writings of Thomas Paine,* edited by Philip Foner (New York, Citadel, 1961).
[19] Please see Thomas Jefferson, *Writings*, edited by Merrill Peterson (New York, Library of America, 1984).
[20] Melinda Roberts and David Wasserman (eds.), *Harming Future Persons. Ethics, Genetics and the Nonidentity Problem* (Dordrecht, London: Springer, 2009).
[21] Walter Glannon, *Genes and Future People: Philosophical Issues in Human Genetics* (Cambridge, MA: Westview Press, 2001).

that natural disadvantages cannot be redressed. They could only be compensated by increasing the bundle of other types of resources.

In 1953, Watson and Crick's description of the double helix structure of DNA had immense repercussions not only in biology and its adjacent fields, but also in more distant areas. The unraveling of the DNA represents the cornerstone of molecular biology and, consequently, of genetic technology. The latter allows us to gather information about our genetic data and, most importantly, it grants us the possibility to manipulate our genes and to change our genomes.

One major implication of genetic technologies for distributive justice is that it transformed the 'natural lottery' of allotting genes into an issue that requires finances rather than luck. Thus, instead of being required to compensate natural disadvantages, economic resources play now a much more fundamental role: because they lie at the very core of the process of distributing genes, they are now responsible for it. The allocation of genetic interventions could now have four possible consequences: (1) redress natural inequalities; (2) eliminate social injustice; (3) deepen already existing injustices; (4) create new types of social injustice.

Because it requires economic resources, we could perceive genetic justice as a subcategory of socio-economic justice. However, true as that might be, an account that would reduce the issue of gene distribution merely to a problem of finances would be utterly incomplete. The reason lies in the nature of the gene itself, which is a unit of selection through replication. As a consequence, it represents a bridge that links the past to the present and the present to the future. If current generations alter their genomes, then their selected genes will pass into the gene pool that will affect the constitution and, implicitly, the well-being of the future individuals. Thus, apart from pure distributive concerns, an ethical assessment of the desirability of different genetic procedures is also needed in order to endure just intergenerational relations.

A theory of genetic justice needs to answer three questions. The first is the problem of the currency or, in other words, of *what* is to be distributed. The second relates to the pattern, or *how* the object is going to be distributed. Finally, the third is the issue of weight, which is concerned with the macro-allocation of resources and, implicitly, with *how much* emphasis should be put on genetic disadvantages as opposed to other types of disadvantages.[22]

Some of the literature dedicated to health and health care distribution can also be applied to genetic justice. In many occasions, it contains specific references to the distribution of genetic interventions, while, at other times, it has implications that could be transposed to the latter field as well. This is due to the fact that, ultimately, most genetic therapies have the same aim as non-genetic medical procedures, which is treatment and prevention. It is important to stress the fact that most current health conditions have a genetic component which makes it impossible for classical medicine to treat them. Autoimmune diseases or X- chromosome related conditions, for instance, can only be maintained within certain limits by non-genetic interventions, but not cured. However, there is a main difference between classical and genetic therapies, which resides in the latter's extended capacity to enhance.

The literature relevant for the distribution of genetic technologies - whether it is crossed with that on health and health care distribution or not - can either follow the path of Rawlsian egalitarianism or of luck egalitarianism. Among the proponents of the former, it is worth mentioning Norman Daniels, Allen Buchanan and Colin Farrelly.

In *Just Health*, Daniels supports the idea that health is morally important because of its function, which is that of protecting the 'normal opportunity range'. The normal opportunity range consists of all the opportunities that one might have in a certain society given one's talents.

[22] Colin Farrelly, "The Genetic Difference Principle," *American Journal of Bioethics* 4:2 (2004): 21-28 and Shlomi Segall, *Health, Luck, and Justice* (Princeton and Oxford: Princeton University Press, 2010).

Health has the strategic importance of being crucial for the ability to choose and pursue a reasonable plan of life. As such, society ought to distribute it in such a way that individual shares of the normal opportunity range, associated to the range of available life plans for each, are equalized. However, a just distribution should only take into account cases of disease and disability, perceived as departures from normal functioning, and not genetic enhancement.[23]

Allen Buchanan also discusses the role of the principle of equal opportunity in the application of genetic interventions. According to him, the Resource Equality, as well as the Resource Redress Principles cannot justify the redistribution of genes in the name of equal opportunity. Nonetheless, equal opportunity can fulfill two functions that are of great significance in determining the moral uses of genetic technology. The first is that of constraining the employment of genetic technologies in order not to deepen already existing inequalities. The second refers to imposing obligations to use genetic technologies in such a way that it would prevent genetic harms resulting in deprivations.[24]

Another follower of Rawlsian egalitarianism, Colin Farrelly examines three distributive principles as possible candidates for assessing the relation between genetics and justice: 'genetic equality' (GE), a 'genetic decent minimum' (GDM) and the 'genetic difference principle' (GDP). These principles are grounded in three distinct doctrines, namely, egalitarianism, sufficientarianism and prioritarianism. Farrelly provides two types of interpretations for all three distributive principles: a broad/stringent understanding, together with a narrow/ minimalist reading. Thus, while the broad GE requires the equalization of all genetic traits that have a significant impact on one's life prospects, the narrow GE limits its application to fewer goods (such as, for instance, though not necessarily, health and/ or longevity). Following a similar pattern, the broad GDM would account for all those capabilities that are essential to living a decent life, whereas the

[23] Norman Daniels, *Just Health* (Cambridge: Cambridge University Press, 2008).
[24] Allen Buchanan: "Equal Opportunity and Genetic Intervention", *Social Philosophy and Policy* (1995): 105-135.

minimal GDM requires the prevention or amelioration of important limitations due to disease. Finally, the stringent GDP demands that 'inequalities in the distribution of genes important to the natural primary goods are to be arranged so that they are to the greatest benefit of the least advantaged.'[25] The lax GDP, on the other hand, introduces the condition of the *reasonableness* of the benefits of the worse off. Farrelly considers that the best principle that can regulate the relation between genetic intervention and distributive justice is the lax GDP. Because it does not give absolute priority to the interests of the least advantaged, it can cope well with the problems of currency, weight and reproductive freedom.

If applications of Rawlsian egalitarianism to genetic justice usually perceive genetic technologies as a means for treating disease and disability, luck egalitarians go beyond this role. It is morally permissible for genetic interventions not only to treat, but also to enhance. According to Segall, '[j]ustice in health requires correcting unchosen bodily traits even when the latter are not pathologies.'[26] Unchosen bodily traits are the products of brute luck, which in Segall's view is linked to unreasonable avoidability and which, ultimately, is the main target of the luck egalitarian redistribution. Another point on which Segall disagrees with Rawlsian egalitarians is the importance of effort for a theory of justice applied to health care. Whereas the former do not make any reference to effort, luck egalitarianism endorses the idea that

> [f]airness requires assigning priority to improving the health of an individual if she has invested more rather than less effort in looking after her health, and of any two individuals who have invested equal amounts of effort, giving priority to those who are worse off.[27]

Another important question to which a theory of genetic justice should answer is the following: who holds the responsibility for deciding which traits will be genetically engineered and

[25] C. Farrelly, op. cit., p. 7.
[26] S. Segall, op. cit., p. 121.
[27] S. Segall, op. cit., p. 119.

how they will be distributed? Should these decisions be made in the public or in the private sphere? In one famous footnote, Robert Nozick embraces the latter point of view:

> Consider…the issue of genetic engineering. Many biologists tend to think the problem is one of design, of specifying the best types of persons so that biologists can proceed to produce them. Thus they worry over what sort(s) of person there is to be and who will control this process. They do not tend to think, perhaps because it diminishes the importance of their role, of a system in which they run a 'genetic supermarket', meeting the individual specifications (within certain moral limits) of prospective parents… This supermarket system has the great virtue that it involves no centralized decision fixing the future of human type(s).[28]

As a response, Peter Singer formulates three objections that can be brought against Nozick's proposal. First, if decisions on gene distribution are to be made in the private sphere, then individuals will seek those traits that would offer them and their offspring comparative advantages. Second, as most people will seek approximately the same characteristics, this will lead to a lack of human diversity. Finally, as it requires wealth, genetic engineering which is left unregulated by the state can result in the creation of a genetic hierarchy that undermines the ideal of equality of opportunity.[29]

3. Contribution

The possibility of any piece of writing to make a contribution to the literature is significantly dependent on its relevance. Why is genetics important and why should one link it to the interests of future generations? As several studies show, our genetic material is responsible, to a great extent, for our appearance[30], behavior[31], talents or intelligence[32]. Genetic engineering affects future

[28] Robert Nozick, *Anarchy, State and Utopia* (New York: Basic Books, 1974): 315 n.
[29] Peter Singer, "Shopping at the Genetic Supermarket" in S. Y. Song, Y. M. Koo and D. R. J. Macer (eds.), *Asian Bioethics in the 21st Century* (Tsukuba, 2003).
[30] Lango Allen et al. concluded in a 2010 study that height was approximately 90% inheritable in the Western populations. For more details, please see Hana Lango Allen et al. ,"Hundreds of variants clustered in genomic loci and biological pathways affect human height", *Nature,* 467 (2010): 832–838.
[31] Please see J. Alford, C Funk, and J Hibbing, "Are Political Orientations Genetically Transmitted?" *American Political Science Review* 99 (2005):153–67; L. J. Eaves and Hans J. Eysenck, "Genetics and the development of social attitudes", *Nature* 249 (1974):288-289; P. K. Hatemi, J Alford, J Hibbing, M Keller, N Martin, S Medland and LJ Eaves, "Not by

generations because it offers the present generation the possibility of making genetic modifications that can also extend to future persons. As such, current people have the potential of affecting essential traits that are intimately tied to the health and well-being of future generations. Furthermore, genetic procedures can significantly alter the natural and social environments of the generations to come.

Conceived as a bridge between the field of genetic justice and that of future generations, this thesis will contribute to both of these areas in at least three ways. First, it asks a question that has been neglected by the current literature and it relies on a perspective that has been so far overlooked. Thus, although genetics has a predilection for unborn people - as it is much easier to transform their genomes -, the consequences of present distributions of genetic interventions for future generations have not been properly considered.

Second, a crucial area of concern is the moral permissibility of human germline therapies. Debates related to germline interventions are not new. McGleenan[33] and Resnik[34], for instance, discuss the slippery slope argument according to which (1) germ line therapy leads to negative eugenics and then (2) negative eugenics results in positive eugenics. On the other hand, Simon considers that a dangerous implication of intervening in the germ cells is that of the uniformity of the gene pool which constitutes 'an offence to the individuality protected by human dignity.'[35] Scientists also raise some objections against this type of therapies by focusing on the risks that the

Twins Alone: Using the Extended Twin Family Designed to Investigate the Genetic Basis of Political Beliefs", *American Journal of Political Science* 54(3) (2010):798–814.

[32] Chabris et al. have shown in a 2011 study that most reported associations between specific single-nucleotide polymorphisms (SNPs) and general intelligence are false positives. However, they also confirmed the result that about 50% of the variance in IQ is inheritable. For more details, please see Chabris et al., "Most Reported Genetic Associations with General Intelligence are Probably False Positives", *Psychological Science* (2011).

[33] Tony McGleenan, "Human Gene Therapy and Slippery Slope Arguments", *Journal of Medical Ethics* 21 (1995): 350-355.

[34] David Resnik, "Debunking the Slippery Slope Argument Against Human Germ-Line Gene Therapy", *The Journal of Medicine and Philosophy* 19 (1994): 23-40.

[35] Jürgen Simon, "Human Dignity as a Regulative Instrument for Human Genome Research" in Cosimo Marco Mazzoni (ed.), *Ethics and Law in Biological Research* (The Hague: Kluwer Law International, 2002): 35-45.

procedures would pose to the fetus, such as abnormal development or long-term side effects.[36] The way in which I am going to approach this issue is by focusing on the health of future generations. Thus, my argument concerning germline interventions is, first of all, restricted to those interventions whose effects cannot be controlled, and it rests on two different grounds: (1) our imperfect information with respect to the changes that are bound to occur in our natural and social environment and, thus, our inability to know which traits can be supported by natural selection and be beneficial in the long run; (2) uniformity in individuals' genetic choices, which will lead to uniformity in the gene pool. The lack of diversity in the human gene pool can have two negative repercussions for future generations: (1) reduction of heterozygosity, which is associated with a health or performance advantage; (2) uniformization of the genes involved in reproductive recombination, which may lead to the health risks involved in asexual reproduction.

Finally, my thesis can contribute to the existent literature by re-defining in a more specific manner concepts that are ambiguously used, such as, future generations, future people, enhancement, treatment, prevention.

4. Methodology

I use *reflective equilibrium*[37] in the attempt to build strong arguments by moving back and forth from particular cases to general principles. This is also evident in my heavy reliance on objections as important tools for refining my main arguments. Given the highly applied nature of bioethics, I believe *induction* is extremely useful for discussing some of the moral implications of genetic

[36] Please see Gene Therapy Advisory Committee, *Third Annual Report* (1996), Health Departments of the UK, available at http://www.advisorybodies.doh.gov.uk/genetics/gtac/forward.pdf

[37] Please see Norman Daniels, "Reflective equilibrium in theory and practice" and "Wide reflective equilibrium and theory acceptance in ethics" in his *Justice and Justification: Reflective Equilibrium in Theory and Practice* (Cambridge: Cambridge University Press, 1996), pp. 1-17 and pp. 21-46.

technologies. Other tools that I employ are *thought experiments*[38] and *analogies*[39]. A serious methodological challenge that I met while writing this thesis is that of the speculative nature of the empirical assumptions that I had to make. I propose a principled way to cope with this issue in Chapter 5.

5. Structure

This thesis is divided into 6 chapters. I start by defining the concept of future generations and by illustrating the various forms that a genetic intervention could take. In Chapter 2, I present the differences between somatic and germline manipulations, while the emphasis is laid on the latter's implications for future generations. Chapter 3 is dedicated to discussing the meaning and limits of human enhancement, as compared to treatment and prevention. Although the scope of the thesis is restricted to *genetic* procedures, I refer to non-genetic enhancements as well, because I believe that they can cast more light on the moral underpinning of the genetic typology. Due to the fact that human enhancement has sparked so many controversies, I present and respond, in Chapter 4, to some of its most compelling objections. Chapter 5 discusses the implications of genetic enhancement for future generations, while Chapter 6 deals exclusively with the intersection between distributive justice, genetic enhancement and future generations.

[38] Please see D. Leopold and M. Stears (eds.): *Political Theory: Methods and Approaches* (Oxford: Oxford University Press, 2008).
[39] Please see Frederick Schauer, *Thinking Like a Lawyer: A New Introduction to Legal Reasoning* (Cambridge: Harvard University Press, 2009).

CHAPTER 1

Conceptual Clarification: Future Generations and Genetic Interventions

'When I use a word', Humpty Dumpty said
in a rather scornful tone, 'it means just what
I choose it to mean – neither more nor less.'
(L. Carroll)

Similarly to most argumentative enterprises, the validity of an inference is very much dependent on the meaning of its constitutive notions. Equally true is the fact that the interpretation of a concept in the social sciences and humanities can considerably vary according to the beliefs held by the interpreter. The main notions of my inquiry do not strike a dissonant note in this respect. While the meaning of some can easily be deduced either from context, intuition or simply previous readings, others are prone to more ambiguity. The aim of this chapter is to dissolve such imprecision by providing the reader with guidelines meant to clarify those terms that are susceptible to multiple readings.

The first notion that would require further consideration is that of future generations. There are several conjoined reasons that would point toward the need for the isolation and additional explanation of this concept's meaning. The most important one is that this dissertation is aimed at analyzing issues of genetic justice from the perspective of future generations. As such, they constitute the main subject of this discussion. Furthermore, the current literature on intergenerational issues fails to clearly specify the proper domain that future generations occupy. Are all people living in the future members of the future generation? Among them, should we

distinguish between unborn people, on the one hand, and, on the other, currently living individuals whose existence, other things being equal, will most likely be prolonged in the future? Moreover, should we keep on differentiating within the former category between several kinds of unborn people? If so, what criteria should one employ? The first section of this chapter will deal with such and other similar questions.

My second terminological concern revolves around a cluster of notions that can be grouped under the broader umbrella of the family of genetic interventions. They constitute the object or currency of genetic justice and, as such, are meant to respond to the following question: what is to be distributed by a theory of genetic justice? The diversity of this currency may lead to differential justice requirements. In order to understand how to approach and conceptualize nonlinear duties of justice, one needs to address first the foundation of such differentiation. What is so special about some genetic interventions that they trigger more stringent justice-based obligations than others? The second section of this chapter will target such considerations.

1. Future generations

Any discussion of future generations should proceed from the definition of the concept of 'generation'. The standard criterion for separating generations is the date of birth. If we follow this direction, then generations equate birth cohorts. A birth cohort can be defined as a group of people that are born in the same period. Neil Buchanan criticizes this demarcation method by arguing that people that are born at the same time do not also die at the same time.[40] As such, they may fail to establish the temporal connection that represents a necessary element of any account that deals with the notion of generation. The result would be that although an individual would live 50 or more years around people that were born earlier or later than herself, they would not be regarded as

[40] Neil Buchanan, "Government Finances Today and Economic Prosperity Tomorrow: What Do We Owe Future Generations?", *George Washington Law Review* 1237 (2009).

members of the same generation. Nonetheless, she would be in the same generation with someone that was born in the same day, but died in less than a year. As it excludes long temporal connections between people born at different periods of time, this view is incomplete due to its narrowness.

An alternative to the birth cohort view is the age group perspective. According to it, generations can be defined as age groups, the latter being comprised of people sharing the same age. Unfortunately, this view also suffers from narrowness. If only people that have the same age are part of the same generation, then we could have more than 80 co-existing generations. This may pose both theoretical and practical difficulties, as it would equally complicate discussions of intergenerational justice and their integration in policy choices.

A defender of the age group view may argue that my understanding of 'same age', as reflected by my previous conclusion, is not the correct interpretation of the concept. Same age may or may not be taken literally. If we follow the latter direction, then same age group may condense more ages in the same category. For instance, 0-1 year, 1-3 years, 20-29 years or 30-29 years could all represent individual age groups. These typologies may be useful for designing and implementing public policies in a differential way, targeting specific segments of the population. However, such an account may not lay at the foundation of a theory of justice aimed at addressing the nature of the moral relation between individuals that do not live at the same time. As such, it ignores the connections between current, past and future people. Ultimately, even in this second interpretation of the age group view, the issue of narrowness cannot be avoided.

It seems that both the birth cohort and the age group view cannot provide a correct understanding of what a generation is. The connecting element between individuals that are part of the same generation needs to be something more than the date of birth or age. An inquiry into this direction requires the isolation of the main characteristics of a generation. The undisputed feature of a generation is its temporal connection. Thus, as trivial as it may sound, individuals can interact and

relate to each other only if they live at the same period of time. This is the common denominator of any discussion centered on generational issues and the one that can offer the broadest perspective. Normative inquiries, in general, and theories of justice, in particular, can best work with a broad understanding of what a generation is. Only a broad definition could capture the triangle formed between past, present and future individuals and the discussions of justice revolving around it.

Taking all this into account and trying to avoid the problem of narrowness, I propose as a demarcation criterion among generations the period of time in which a human being is alive. Thus, by 'present generation', I understand those individuals that are alive at the current moment. 'Past generation' refers to the people that are no longer alive and "future generations" to those individuals that will actually be born in the future, and not to those that might be born in the future. In this way, generations can be very precisely separated, although individuals may establish more than one generational relation with the others. For instance, Derek, born in 1942, is for John, born in 1921, part of the future generation. In 1943, both of them are members of the present generation, while in 2002, when John dies, he becomes a member of the past generation in relation to Derek.

After having defined the concept of generation, let us now have a closer look at what future generations are. Future generations are characterized by several specific traits. First of all, they are *not actual*, meaning that they do not exist in the present. Second, they are *indeterminate,* in the sense that we do not know who they are or will be. However, it is *certain* that future generations will come into existence at one point. At the same time, they have *potential interests* that the present generation can affect.

What kind of interests can future generations have? Due to a lack of information on how the future will be, we can assume that there will be an asymmetry of interests between different generations. However, we can also infer that future people will have interests that would be reasonable to expect from any human being in any period of time. Such examples can include, for

instance, health and well-being. Joel Feinberg also endorses this point of view: 'Five centuries from now men and women will be living where we live now. Any given one of them will have an interest in living space, fertile soil, fresh air, and the like […].'[41]

Because the interests of future people are merely potential and not actual, Feinberg believes that this could lead us to a slippery slope: 'it may seem at first sight that anything at all can have potential interests, or much more generally, that anything at all can be potentially almost anything else at all.'[42] Thus, any *X* can become *Y* provided that elements *a, b, c, d* meet. In order to isolate the importance of the potential interests of future generations, Feinberg argues that there are degrees of potentiality. There are two criteria that can be used in order to assess whether X is a proximately or a non-proximately potential Y. The first criterion is the causal importance, which can be defined as the 'difficulty or ease of providing those missing elements.'[43] The second is the degree of deviation from the normal course of events. In a small deviation from the normal course, 'if no one deliberately intervenes to prevent it from happening, it will, in the vast majority of cases, happen.'[44] The interests of future generations are proximately potential because (1) it is certain that future generations will at one point come into existence, which (2) represents the missing link in the actualization of their interests and which (3) constitutes a part of the normal course of events.

According to the Interest Theory present within legal literature, a person that has an interest becomes a right holder correlative to whom her right addressees have duties.[45] A question that naturally follows from here is related to the way in which we should conceive of future generations as a type of interest and right holders. In other words, toward whom exactly should the duties of current people be discharged when we think about the future?

[41] Joel Feinberg, "The Rights of Animals and Future Generations" in William Blackstone (ed.), *Philosophy and Environmental Crisis* (Athens, Georgia: University of Georgia Press, 1974): 57.
[42] J. Feinberg, op. cit., p. 58.
[43] J. Feinberg, op. cit., p. 58.
[44] J. Feinberg, op. cit., p. 59.
[45] Ori J. Herstein, "The Identity and (Legal) Rights of Future Generations", *The George Washington Law Review* Vol. 77 No. 5/6 (September 2009): 1197.

Ori Herstein presents a comprehensive argument on this issue. In his viewpoint, there are three possible directions that can be followed in answering this question. In their capacity as interest holders, future generations could be perceived as (1) future individuals, (2) groups or (3) types of future people. The first option is not a good approach because individuals are characterized by particularity, whereas future generations, in spite of their properties, do not exist as particulars.[46] Future generations cannot be conceived as groups either. Groups have a moral worth and a role in determining the well-being of their members. Moreover, they exhibit a kind of cohesion that goes beyond facts of no moral significance, such as that of being solely composed of age groups or birth cohorts.[47] Having dismissed the first two options, Orstein argues in favor of the third. Thus, future generations can best be understood as types of future persons. 'A type of person is not an individual but a set of properties that more than one individual may exhibit.'[48] This homogenous view of future generations can best accommodate the unity of interests of all future people, which they uphold as a single type of person, given that these interests are common to all humans.[49]

I will also follow this approach, as apart from its intrinsic value, it proves to be compatible with the properties of future generations mentioned earlier. Part of the significance of these properties resides in the fact that they can help us differentiate between future generations and the other two types of future people, namely, fetuses and unborn members of an identifiable family line. Let us have a look at each of these traits in turn and see what makes the three categories of unborn people distinct.

The first property, actuality, differentiates mainly between future generations and fetuses. While the former do not exist in the present, the latter do have a present existence as fetuses, which

[46] O. Herstein, op. cit., pp. 1194-1195.
[47] O. Herstein, op. cit., pp. 1175-1180.
[48] O. Herstein, op. cit., p. 1182.
[49] O. Herstein, op. cit., p. 1182.

brings them the closest to being actual individuals. Second, while there is certainty with respect to the future existence of future generations, there is no such thing regarding fetuses or unborn family members. Third, future generations are supposed to be indeterminate. This cannot apply to fetuses or the unborn members of a family because they restrict the sphere of indeterminacy: while we know nothing about future generations, we do have some minimal information with respect to the other two types. Finally, both fetuses and family members have interests that shape intergenerational relations and assign obligations in a very specific way. For instance, not all members of the present generation are responsible for the interests of fetuses or the future members of a certain family. These obligations fall on particular individuals, such as parents, relatives or physicians, who already stand in a special relation with the former. However, the interests of future generations do trigger obligations on the part of all individuals comprising the current generation.

In order to arrive at a meaningful conclusion, any discussion of future generations and their interests needs to surpass one obstacle: the Non-Identity Problem. I do not intend to address this problem in depth in my thesis, nor to provide it with an original solution. My aim is more modest than that and it consists merely in showing that there are some plausible answers to this puzzle in the current literature, which will enable me to proceed with my topic.

Parfit's Origin View states that '[e]ach person has the distinctive necessary property of having grown from the particular pair of cells from which this person in fact grew.'[50] This leads to the Time Dependence Claim, according to which '[i]f any particular person had not been conceived when he was in fact conceived, it is in fact true that he would never have existed.'[51]. Thus, our choices can affect who will be born in the future and this has important repercussions on the way in which we come to perceive of our moral duties toward future people. In this sense, how can we refrain from

[50] Derek Parfit, *Reasons and Persons* (Oxford: Clarendon Press, 1984): 351.
[51] D. Parfit, op. cit., p. 351.

performing certain actions (such as, for instance, pollution, slavery, genetic engineering), if these specific actions bring future people into existence?

David Heyd proposes four possible approaches to the Non-Identity Problem[52]:

1. Denying it is a problem to begin with.

2. Aspiring to solve it in some (yet unknown) integrative moral theory in the future.

3. Attenuating it so as to make it more palatable to our moral intuitions and theories.

4. Biting the bullet, i.e. accepting all the implications of the nonidentity problem.

Because the literature dedicated to the Non-Identity Problem is extremley generous, discussing the viability of each of the four points in detail could constitue the topic of an independent thesis. However, we can also briefly assess them by looking at their consequences and comparing them to our moral intuitions. The implications of the fourth approach would basically deny the existence of any duties that the present generation has toward the future ones. As such, justifying all the actions that current individuals perform would lead to the harm of the actual people living in the future. The third approach would be an unstable compromise. Attenuation can mean a partial or an *ad hoc* solution, which cannot be theoretically satisfying.[53] We are thus left with the first two options, which are meant to dismiss the implications of the problem either by solving it or denying it altogether.

There are three main lines along which the literature attempts to formulate an answer to the Non-Identity Problem: (1) life conditions, (2) harm and (3) the difference between actual and potential future people. A proponent of the first approach, Kavka appeals to the concept of 'restricted life', by which he understands 'a life that is significantly deficient in one or more of the

[52] David Heyd, "The Intractability of the Nonidentity Problem" in Melinda Roberts and David Wasserman (eds.), *Harming Future Persons. Ethics, Genetics and the Nonidentity Problem* (Dordrecht, London: Springer, 2009): 5.
[53] D. Heyd, op. cit., pp. 9-10.

major respects that generally make human lives valuable and worth living.'[54] We should not be allowed to create restricted lives and, thus, we should refrain from pursuing policies that could lead to them.

There are several types of arguments revolving around the issue of harm that were formulated as an answer to the Non-Identity Problem. I will only outline here one attempt that I found convincing, namely, that put forward by Elizabeth Harman. The Non-Identity Problem rests on the idea that a person is harmed only if she is made worse than she would have been under an alternative act.[55] Harm is, thus, perceived in a comparative manner. Harman's account, on the other hand, looks at harm in a non-comparative way. According to her, bad states ('pain, mental or physical discomfort, disease, deformity, disability, or death'[56]) are 'in themselves bad, not bad because they are worse than the state the person would otherwise have been in.'[57] Her strongest argument against the Non-Identity Problem and its implications is that an action that both harms and benefits a person that does not exist independently of that action cannot be justified insofar as failing to perform it would benefit someone else.

The conflicting interests between actual and potential future individuals is very well captured by Rivka Weinberg. In her account, actual future people are interested in 'the goods of a good life',[58] whereas potential future people in existence itself. The Non-Identity Problem treats only the latter as interest bearers. Weinberg perceives this as a serious fault because '[m]erely possible people […] are of no moral relevance and do not have any real interests.'[59] Therefore, the Non-Identity Problem is 'morally mistaken and cannot serve as an excuse for neglecting the life interests of future people.'[60]

[54] Gregory S. Kavka, "The Paradox of Future Individuals", *Philosophy and Public Affairs,* Vol. 11, No. 2 (1982): 105.
[55] D. Parfit, op. cit., p. 374.
[56] Elizabeth Harman, "Harming as Causing Harm" in Melinda Roberts and David Wasserman (eds.), *Harming Future Persons. Ethics, Genetics and the Nonidentity Problem* (Dordrecht, London: Springer, 2009): 139.
[57] E. Harman, op. cit., p. 139.
[58] Rivka Weinberg, "Identifying and Dissolving the Non-Identity Problem", *Philosophy Studies* 137 (2008): 8.
[59] R. Weinberg, op. cit., p. 8.
[60] R. Weinberg, op. cit., p. 8.

If, as we have seen, the Non-Identity Problem can be dealt with, then it makes sense to talk about future generations and their interests. I am going to proceed with my main argument on genetic justice and future generations in the next chapters, after having discussed first the diverse typologies of genetic interventions.

2. Genetic interventions: clarification through classification

According to a medical dictionary, a genetic intervention can be defined as the:

> directed modification of the gene complement of a living organism by such techniques as altering the DNA, substituting genetic material by means of a virus, transplanting whole nuclei, transplanting cell hybrids etc.[61]

Genetic interventions or manipulations encompass a substantial array of subtypes, which can be classified along three main lines: time of the intervention, object and aim. According to their aim, genetic procedures can be integrated into three categories: treatment, prevention and enhancement. According to their object, they can target somatic cells or the germline. A more in depth discussion following these two demarcation criteria - and especially germline modifications and enhancements, which could be reasonably considered to raise most ethical concerns - will be offered in the next chapters. For now, I would like to refer to the temporal dimension of genetic procedures, which constitutes a recurring theme throughout the thesis and whose many facets will be addressed in different sections, as demanded by the saliency of various moral considerations.

Having cleared these structural details, the time of the intervention distinguishes between pre-birth and post-birth genetic manipulations. In turn, the former may be divided into embryonic and fetal procedures, while the latter into pre-adulthood and post-adulthood gene therapy. This temporal criterion for differentiating among genetic interventions is tightly linked to important moral and legal issues, such as those concerning the respect for the autonomy of the patient or the

[61]Medical Dictionary Online available at http://www.online-medical-dictionary.org/definitions-g/genetic-intervention.html Last accessed: January 2013.

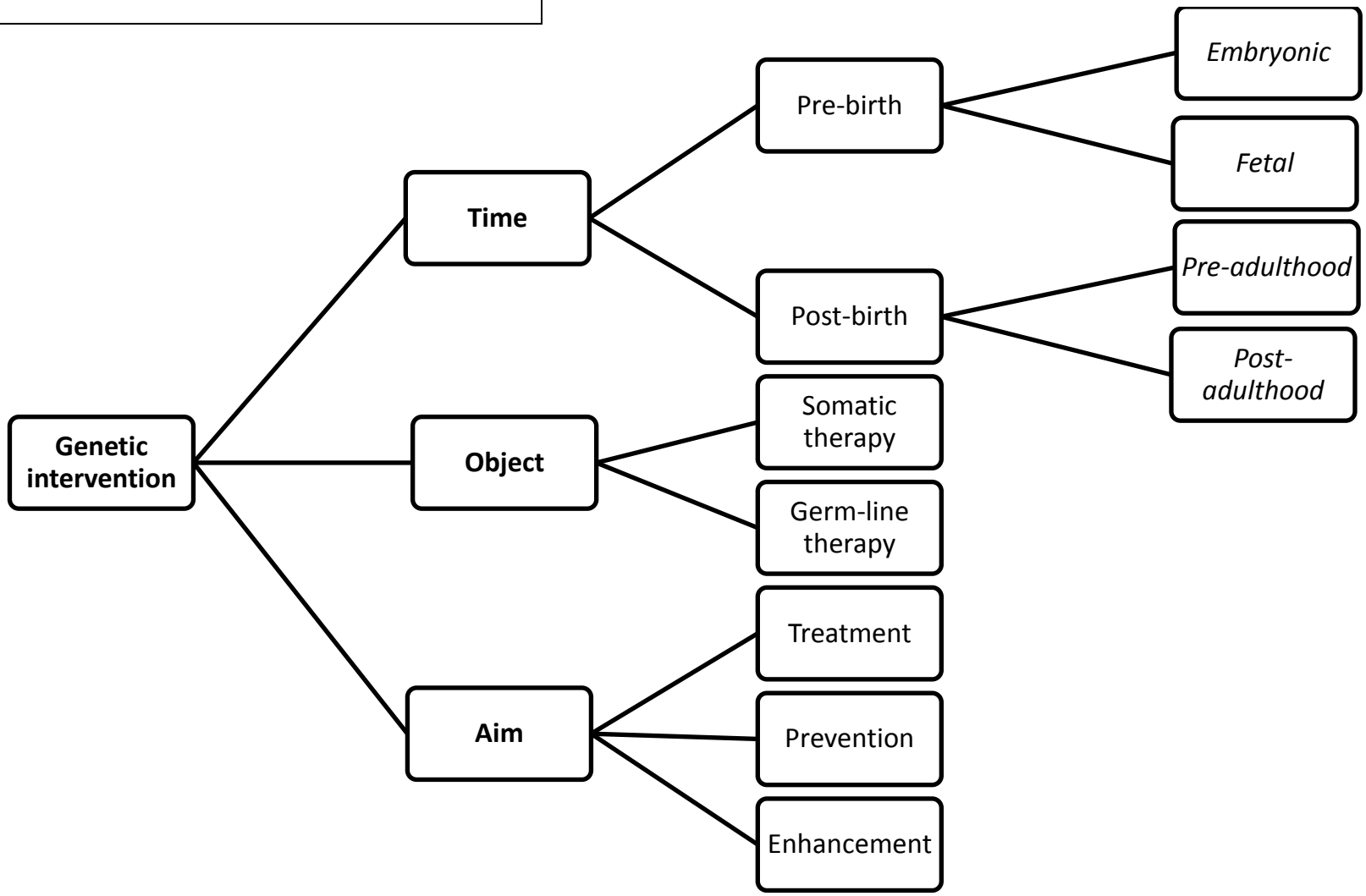
obtainment of her valid consent. The end result of this classification puts forward some interesting and equally disturbing facts: out of four subtypes of genetic interventions, only in one of them, namely in the one occurring during the adulthood stage, can the preferences of the patient be expressed through her consent or lack thereof. Decision-making in the remaining three categories cannot follow the same logic, but needs to take a surrogate form.

According to Buchanan and Brock[62], surrogate decision-making may be guided by one of the following principles: advance directives, substituted judgment and the best interest standard. Advance directives cannot be applicable to the case of embryos, fetuses or children, as they represent living wills made by competent persons in the eventuality that they become incompetent. Substituted judgments suffer from a similar flaw. They entail that the surrogate decision-maker will act in the same way in which the patient would have acted if she had still been competent. The principle of substituted judgment assumes that the patient has once been competent and expressed her views of the world, views that are known to her current surrogate decision-maker. Since embryos, fetuses and children could not have previously enjoyed the status of competency, this principle cannot provide satisfactory guidance to their particular cases.

Through elimination, we are left with the best interest tenet. It wouldn't be the optimal approach to resort to this principle only on negative grounds, without also highlighting its intrinsic value for the situation at hand. Which is why I will continue with a positive argument in its defense. According to the best interest standard, the surrogate decision-maker ought to take into account the best interest of the incompetent patient when opting for the medical track that is to be further pursued. Best interest is to be understood as both current as well as future best interest.

[62] Allen Buchanan and Dan Brock, *Deciding for Others: The Ethics of Surrogate Decision-Making* (Cambridge, NY: Cambridge University Press, 1989).

Figure 1: The classification of genetic interventions



The decision made in this way might be considered a fairly objective one, as it would assess what the best interest is in a given context without benefiting from much subjective input. The patient's incompetence, in the case of already born children, or inexistence, when we are referring to embryos and fetuses, lead to a diminished influence that they could exert in choosing a course of action. On the other hand, the fact that the surrogate decision-maker does not have access to much information regarding the preferences of the patient means that she would have to make the kind of inferences that any other individual might make in that specific situation. Thus, her decision can be put under scrutiny within the framework of public reason. If any reasonable individual can consent to such a choice, then, although this does not constitute a guarantee, it might be the next best thing in pursuing the best interest of the incompetent patient. The appeal of the best interest principle lies in the fact that it grants a framework of reasonableness and objectivity to the decisions that are made under its guidance, which considerably diminishes the chances of wronging the incompetent individual in whose name the decisions are being made.

The temporal dimension of a genetic intervention poses different moral challenges in different contexts and it illustrates sensitive concerns in the child-parent relationship. In the next chapter, I will proceed to analyzing somatic and germline therapies and their ethical implications for future generations.

CHAPTER 2

Germline Interventions and Their Implications for Future Generations

'Tut, tut, child!', said the Duchess.
'Everything's got a moral,
if only you can find it.'
(L. Carroll)

By looking at the object of the genetic manipulation, one can distinguish between somatic cell therapies and germline therapies. Somatic cell interventions target a specific set of somatic cells within the patient's body (for instance, brain cells or liver cells) and their effects are usually restricted to the patient undergoing the procedure.[63] On the other hand, germline therapies aim at modifying the gamete cells (egg and sperm) or embryo and, as such, the genome of the recipient with the purpose of transmitting these changes to her descendants.

The possibility of intervening in the genetic make-up of unborn people brought the issue of germline therapies to the attention of bioethicists and other moral philosophers. In this sense, one major source of concern is the implications of such interventions for eugenic policies. McGleenan[64] and Resnik[65], for instance, discuss the slippery slope argument according to which (1) germ line therapy leads to negative eugenics and then (2) negative eugenics results in positive eugenics. Negative eugenics is understood, in this context, not as prohibiting the reproduction of the unfit,

[63] There is also the possibility of inadvertent germline gene transfer. See, for example, Nancy M.P. King, "Accident & desire: inadvertent germline effects in clinical research" *Hastings Center Report,* 2003; 33(2): 23-30.
[64] Tony McGleenan, "Human Gene Therapy and Slippery Slope Arguments", *Journal of Medical Ethics* 21 (1995): 350-355.
[65] David Resnik, "Debunking the Slippery Slope Argument Against Human Germ-Line Gene Therapy", *The Journal of Medicine and Philosophy* 19 (1994): 23-40.

but rather as preventing the spread of unfit genes by relying on genetic therapies. While negative eugenics is aimed at reducing unwanted traits, positive eugenics is a strategic intervention that is meant to promote desirable characteristics. As such, McGleenan and Resnik are basically reinforcing the conflict between prevention and cure, on the one hand, and enhancement, on the other. At his turn, Simon considers that a dangerous implication of intervening in the germ cells is that of the uniformity of the gene pool which constitutes 'an offence to the individuality protected by human dignity.'[66]

Scientists also raise some objections against this type of therapies by focusing on the risks that the procedure would pose to the fetus, such as abnormal development or long-term side effects.[67] However, some of them are equally optimistic that these specific safety barriers can be surpassed in the future and, moreover, there will be no valid objection against germline interventions. In the words of Francis Collin, while speaking in front of the US President's Council on Bioethics in 2002:

> Insertion of transgenes into the germline when you don't know the consequences clearly does not seem like an ethically justifiable activity, but if you could come up with a way to go in and change that T to a C without leaving any footprints on either side of it, then that would potentially come much closer to an acceptable perspective on a safety basis![68]

Unfortunately, even if one manages to surpass the short-term safety issues of germline manipulations, namely those affecting the fetuses, the long-term effects of such procedures are harder to disentangle. As long-term consequences are the ones that can interfere with the interests and well-being of future generations, they constitute a main point of discussion in this thesis.

[66] Jürgen Simon, "Human Dignity as a Regulative Instrument for Human Genome Research" in Cosimo Marco Mazzoni (ed.), *Ethics and Law in Biological Research* (The Hague: Kluwer Law International, 2002): 35-45.
[67] Please see Gene Therapy Advisory Committee, *Third Annual Report* (1996), Health Departments of the UK, available at http://www.advisorybodies.doh.gov.uk/genetics/gtac/forward.pdf
[68] The President's Council on Bioethics, *Genetic Enhancements: Current and Future Prospects* (Washington D.C., 2002).

Employing arguments of a phylogenic nature, one can object to germline modifications by referring to their unknown distant implications on several grounds.

First, humans possess an imperfect knowledge with respect to the evolution of their natural and social environments. Thus, we might not know which traits will be valued by the people living in the future. We could attempt to make some educated guesses, like assuming that a good state of health still represents a benefit, but anything beyond that would be open to speculation. Look at intelligence, for instance. We might not know for certain at this moment whether our descendants and/or their descendants would embrace the rich promises of enhanced cognitive capacities at the risk of decreasing their mood and general mental health.[69] Apart from this, it is hard to anticipate which characteristics that have been naturally selected so far and which are generally perceived as negative might constitute an evolutionary advantage in another setting. These concerns are also raised by several geneticists.

> We know so little about the human body and so little about living processes, we would be unwise to attempt genetic engineering to try to treat, much less "improve", the human zygote or embryo. What our society may want to do 100 years from now is its business. It will not care what we think any more than we care what people 100 years ago thought we should do. However, it is our duty to go into the era of genetic engineering in as responsible a way as possible. This obligation means that we should utilize this powerful new technology cautiously until we learn its problems, and even then, use it only for the treatment of disease and not for any other purpose.[70]

> While we may eventually understand how this marvelous creation, including our brain and other components, actually works, we must keep in mind that the human system is the metastable result of a long evolutionary process, and that the pieces all work together in optimized harmony. Adding new or altered components, however good our knowledge of the system, could have unpredictable consequences. This represents a risk that no one should ask an unborn child to assume.[71]

[69] Please see P. W. Andrews and J.A. Thomson Jr., "The bright side of being blue: depression as an adaptation for analyzing complex problems", *Psychology Review* 116 (2009): 620-654 & R. Greifeneder and H. Bless, "Depression and reliance on ease-of-retrieval experiences", *European Journal of Social Psychology* 38 (2008): 213-230 & Claudia M. Santosa et al., "Enhanced creativity in bipolar disorder patients: A controlled study", *Journal of Affective disorders* 100.1 (2007): 31-39.

[70] W. French Anderson, "A New Front in the Battle against Disease" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 48.

[71] Burke E. Zimmerman, "The Road Ahead. A Panel Discussion" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 126.

> Because human germline gene therapy would be mediated by human beings, and we are far from perfect, there is a potential for error. In addition, no matter how much thought went into the process, twenty or thirty years henceforth may appear naïve in the context of the technology available at that time. Furthermore, whatever improvements could be made at that future date, they too would be subject to being outmoded. For these reasons, it is important that whatever procedures we might adopt for human germline gene therapy, they should, at the very least, be reversible.[72]

Interestingly enough, diseases might not only have downsides, but also positive effects. Genetic mutations can be beneficial in two different ways: they are either necessary for species to adapt to changing environmental conditions or confer a survival advantage on certain populations. For instance, diabetics can deal well with abrupt drops in the temperature, sickle- cell anemia offers a greater resistance to malaria and hemochromatosis constitutes an advantage in the fight against pathogens.[73]

Some might object to this approach by arguing that the harms associated to a chronic disease, like diabetes or sickle-cell anemia, surpass those linked to a merely probable future condition. Even if the rate of incidence of such a condition would be high for all the world population, there may be other less demanding methods for dealing with it. Malaria, for instance, can be prevented through proper vaccination. As such, a genetic disease meant to act as a partial immunization against an easily avoidable condition is not an optimal or just tradeoff.

Although this is a valid argument, it cannot totally dismiss my initial claim. The situation in which someone suffering from a chronic disease may also draw health benefits from it is a quite extreme one. A more moderate view is that related to the advantages of having a diverse human gene pool – diverse meaning that genes linked to diseases would also be present – associated to heterozygote individuals. Those who are heterozygous for a particular gene have two different alleles

[72] Mario R. Capecchi, "Human Germline Therapy. How and Why" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 38.
[73] Sharon Moalem and Jonathan Prince, *Survival of the Sickest* (Harper Collins, 2007).

of that gene, as opposed to homozygote individuals, who would have two identical copies of the gene. In our example referring to sickle-cell anemia, a heterozygote individual would only be the carrier of the condition, without suffering from it but, at the same time, enjoying its benefits.

> The phenomenon of heterozygote advantage points to potential enhancements beyond reducing susceptibility to diseases such as malaria and sickle-cell anemia. For instance, there is some indirect evidence that at least Type I Gaucher's Disease (and possibly other sphingolipid storage diseases) is linked to improved cognition, given the significantly higher proportion of sufferers in occupations correlated with high IQ. (Cochran, Hardy and Harpending, 2006) This, and other circumstantial evidence is used by the authors of the cited study to argue that heterozygote advantage can explain the high IQ test scores and the high prevalence of Type I Gaucher's Disease among Ashkenazi Jews. Should this prediction be borne out by finding an IQ advantage for heterozygote carriers of the diseases, it would suggest that screening to promote heterozygosity, or genetic interventions to induce it, it would be viable forms of cognition enhancement that meet the EOC[74]. [75]

The heterogeneity of the human gene pool, which can be disturbed by the use of germline interventions, is biologically advantageous for the human species not only because it can promote heterozygous traits. There is also a second reason. The uniformization of human genomes can have important repercussions in the field of reproduction as well. Human reproduction is a type of sexual reproduction, which is characterized by the shuffling of parents' genes within a process of recombination. Thus, the human zygote will have 23 pairs of chromosomes, out of which one member of the pair can be traced back to the mother, while the second to the father. Consequently, we have two versions of each gene, one inherited from the mother and the other from the father. In a scenario in which the human gene pool loses its diversity, human sexual reproduction will end up shuffling and recombining the same versions of genes, which will bring it closer to forms of asexual reproduction, like cloning. Unfortunately, asexual reproduction is considered to be inferior to the sexual one, as it is considerably more likely to produce offspring with low resistance to pathogens.[7677]

[74] Evolutionary optimality challenge
[75] Nick Bostrom and Anders Sandberg, "The Wisdom of Nature: An Evolutionary Heuristic for Human Enhancement" in Julian Savulescu and Nick Bostrom (eds.), *Enhancing Humans* (Oxford: Oxford University Press, 2009): 401-402.
[76] Steven E. Kelley and J. Shykoff, "Viral Pathogens and the Advantage of Sex in the Perennial Grass Anthoxanthum Odoratum", *Philosophical Transactions of the Royal Society London,* vol. 346, no. 1317 (1994): 295-302.

In a couple of lines, Michael Rose manages to draw the contours of this problem:

> And then, finally, you have the problem of possible homogenization, which is like all of us driving Toyota Camrys. If we all have the same anti-aging chromosome and, as it turns out, that makes us prone to infection by a virus we've not seen epidemiologically, then we could all be stricken and the consequences might be dire.[78]

To sum up the arguments that I intend to defend in this chapter, performing germline modifications on currently living individuals targets future generations' health and the well-being associated to it by reducing the diversity of the human gene pool. This can have two negative repercussions: (1) reduction of heterozygosity, which is associated with a health or performance advantage; (2) uniformization of the genes involved in reproductive recombination, which may lead to the health risks involved in asexual reproduction. As such, I conclude that germline interventions aimed at modifying the genomes of future people cannot be morally justifiable if there is no possibility of controlling the intervention either by reversing or altering it, whenever need demands it.

An argument can best prove its persuasive strength when confronted with its objections. Thus, the next step that I intend to follow is that of identifying the main lines of criticism that can be brought against my position and to respond to them. The problems that I raise with respect to germline modifications may be criticized on six distinct grounds: safety, population versus individual focus, spontaneous mutations, exceptionalism, the intentional pursuit of genetic diversity through germline interventions, harm reduction potential.

[77] Interestingly enough, this biological fact has also been socially endorsed through the widespread opprobrium concerning incestuous activities.

[78] Michael Rose, "Aging as a Target for Genetic Engineering" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 55.

1. Objection 1: safety

I am arguing in favor of a genetic approach that can safely deal with the well-being of future generations. However, according to some, safety considerations can limit and confine any kind of research because absolute safety is not possible.

> To be serious, when you look at something new, the benchmark for safety must be how hazardous the present process it. When you think of childbirth and conception, it really is a hazardous undertaking – let alone how the children grow up. Absolute safety is never going to be possible. At a certain point, the advantages are going to be clear for an individual.[79]

One strand of my response to the safety objection is that absolute safety was never a formal requirement. However, some degree of safety needs to be maintained, as the magnitude and intensity of the consequences of germline procedures demand it. The magnitude is associated with the large number of people that would be affected by the intervention, which is the numerically unidentifiable group of future generations. Although we do not know the exact figure, it is reasonable to expect it to be large. The intensity of the effects of such modifications was previously discussed in this section and is mainly related to the kind of threats that germline procedures can pose to future generations. Their health was the principal concern, and there is little need to argue for the negative implications of bad health for one's quality of life.

According to Koshland, childbirth is a hazardous undertaking, in the sense that one does not know what kind of child is going to be born and whether he or she is going to suffer from medical or non-medical problems. This a fair claim. However, it is important to emphasize that current medical practice is trying to protect the wellbeing of the future child conceived through natural reproduction and, thus, to neutralize the risk components associated to childbearing by constantly

[79] Daniel Koshland, "The Road Ahead. A Panel Discussion" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 81.

developing new technologies and techniques meant to reveal the possible health problems to which the child is prone.

Prenatal screening is one such widely spread method, aimed at testing fetuses or pre-implantation embryos for certain specific chromosomal abnormalities that could result in diseases that would impair the future child's quality of life. An example of one such highly tested condition is the Down syndrome. Conventional methods for such tests are quite invasive and possibly dangerous for fetuses. They involve either the withdrawal of amniotic fluid that surrounds the fetus or extracting cells from the placenta. Both procedures may pose the risk of miscarriage. The issue of risk, thus, comes again into play. In this context, it is important to stress how crucial the elimination of health-related risks is in the case of pregnancy, be it assisted or non-assisted reproduction. In order to neutralize the health risks caused by the future child's genetic material, one generates another type of risk, namely a procedural one, which can result in miscarriage. We can observe that the problem is prone to circularity, as the desire to avoid certain risks produces risks of its own. This situation can be avoided only if the methods aimed at identifying the first type of risk are, themselves, risk free. And this is the direction toward which prenatal medicine is heading. The demand for less invasive prenatal testing procedures is being met with a body of research that is working on the possibility of using noninvasive blood tests for checking the DNA of fetuses. This could be done by simply collecting a blood sample from the mother. The blood sample will not solely contain medical information about the mother, but also genetic data related to the fetus, as approximately 12% of the fetal DNA is floating in the mother's blood.[80]

In the end, both natural reproduction and germline modifications are prone to risky health outcomes. This parity, however, does not necessarily imply that any of the risks involved in them

[80] Susan Young, "A Brave New World of Prenatal DNA Sequencing", *MIT Technology Review* (Jan 30, 2013), available on http://www.technologyreview.com/news/510181/a-brave-new-world-of-prenatal-dna-sequencing/ Last accessed: January 2013.

should be necessarily accepted and not neutralized. The reason for which I enumerated all the steps that prenatal medicine has taken in order to eliminate unwanted health outcomes related to childbearing was meant to illustrate the attitude toward risk that governs reproduction in general. Thus, if we accept that there are risks involved in both germline interventions and non-assisted childbearing, we should also agree to extend this parallel to their attitude toward risk as well. As such, the safety objection cannot represent a serious constraint against treating germline therapy and its consequences with caution.

2. Objection 2: population versus individual focus

It could be argued that my defense of the diversity of the human gene pool is too much centered on the gene pool itself, while the individual and her well-being are ignored. Eliminating certain genes from the human population would be beneficial for the people who, left un-engineered, would have suffered the harms associated to those particular genetic diseases. When we balance the prevention of such harms with the maintenance of the diversity of the gene pool, it is more likely for the former to weigh more. Eric Juengst captures very well the core of this objection in the following:

> [P]henotypic care and prevention have a moral priority over genotypic prevention.
> To substitute genomes for people as the legitimate receiver of medical care would go against the grain of a liberal medical ethos. […] This, in effect, provides an ethical test for germline interventions: Are they primarily person-centered or gene-pool centered?[81]

I believe that this objection does not manage to pose a real threat to my position on germline modifications because it ignores the foundation of concern. While I do argue that the main problem with germline interventions is that they reduce the diversity of the human gene pool, my argument does not stop here. The homogenization of human genetic traits is not bad in itself,

[81] Eric Juengst, "Prevention and the Goals of Genetic Medicine", *Human Gene Therapy* 16 (1995): 1595-1605.

although some might also defend this thought by appealing to the idea of the sanctity of the human genome, perceived as a common human patrimony. In contrast, I treat the homogenization of the gene pool as having an instrumental, rather than an intrinsic value, in relation to human health and well-being. As previously argued, germline interventions are problematic because, through their impact on the diversity of existing genes, they bear an influence on the quality of life of individual human beings. This influence becomes most visible in the cases of heterozygosity and reproductive genetic recombination. As such, it would be incorrect to characterize this approach as being gene pool, rather than individual centered.

3. Objection 3: spontaneous mutations

A third possible objection to my argument on germline modifications is also focused on the issue of the gene pool, but this time perceived from a different angle. As the criticism goes, one should not worry about eliminating genes from the human population and, thus, reducing genetic diversity. Spontaneous mutations occur all the time and that is the reason why we have so many genetic traits in the first place. Consequently, while certain genes disappear, others will spontaneously appear.

In order to reply to this objection, I first need to stress the differences between natural selection and artificial selection. Natural selection aims at preserving those genetic traits that are essential for survival and fitness. On the other hand, artificial selection is an intended, human guided process that targets the spread of those genes that are associated with the conferring of an advantage, which may or may not be related to survival and fitness. One important distinction between the two is the period of time that they need in order for the selected traits to get adapted. Thus, spontaneous mutations that are naturally selected for need more time for expression in the gene pool, as compared to artificially selected traits. In order to clarify this point, let me provide

some examples. Human evolution itself, from primate to the Homo genus, took more than 100 million years.[82] This can be seen as an extreme portrayal of natural selection at work, as it is focused on a very complex organism situated in an historical context that, unlike current societies, didn't have so many stimuli conducive toward selective pressure. Consider instead a specific trait whose adaptation occurred more recently: lactase persistence or tolerance. Researchers believe that the haplotype responsible for lactase persistence came under strong selective pressure 5,000 to 10,000 years ago.[83] A 1971 study on this issue concluded that, at the time of its publication, only 35% of the human population was lactose tolerant.

> This reveals that lactase non-persistence is the most common phenotype in humans (65% if one takes into account population census size as shown in Table 2 of the supplementary information), with lactase persistence being common only in certain populations with a long history of pastoralism and milking.[84]

The example of lactose tolerance shows how much time a naturally selected for trait needs in order to get spread in the human population.

Let us now turn to artificial selection and its temporal demands. There are numerous examples of selective breeding from the field of agriculture. For instance, the body weight of the artificially selected Atlantic salmon expands by a rate of 30% per generation.[85] Similarly, the weight of the rainbow trout significantly augments after 7-10 artificially bred generations.[86] At their turn, the Sydney-rock oysters, when artificially selected, increase by 4% in the first generation and then by

[82] C. B. Stringer, "Evolution of Early Humans" in Steve Jones, Robert Martin and David Pilbeam (eds.), *The Cambridge Encyclopedia of Human Evolution* (Cambridge: Cambridge University Press, 1994).
[83] J. Hussin, P. Nadeau, J. F. Lefebvre, D. Labuda, "Haplotype allelic classes for detecting ongoing positive selection", *BMC Bioinformatics* 11 (2010): 65.
[84] Robert D. McCracken, "Lactase Deficiency: An Example of Dietary Evolution", *Current Anthropology,* vol. 12, no. 4/5 (1971).
[85] Trygve Gjedrem, "The first family-based breeding program in aquaculture", *Reviews in Aquaculture* 2/1 (2010): 2-15.
[86] L. R. Donaldson and P.R. Olson, "Development of rainbow trout broodstock by selective breeding", *Transactions of the American Fisheries Societies* 85 (1955): 93-101.

14% in the second.[87] Additional examples would all point toward one common fact: artificial selection is a fast process. If we look at its outcome and compare it with that of natural selection, it is evident that the latter cannot really keep up the pace with the former. As such, if we want to argue that the diversity of the human gene pool cannot be threatened by germline modifications, which represent a type of artificial selection, because spontaneous mutations that are being naturally selected for also occur, we need to take into account the asymmetry in terms of reaction time that the two processes exhibit.

4. Objection 4: exceptionalism

Another possible objection brought against my argument on genetic interventions in the germline is founded on the idea that humans are already altering the germ cells through many activities that do not trigger the same moral concern as germline gene therapy does. There are three situations that illustrate the core of this objection. First, prenatal testing associated with embryo selection (in the case of *in vitro* fertilization) and selective abortion (in the case of *in vivo* fertilization) lead to the elimination of certain genes from the future human population. As such, the germline of the individuals that are to be born in the future will be different from what it might have been if the embryos or fetuses had not been screened and the parents had not decided to act upon the received information.

A second situation involves the consequences of providing medical treatment to people who have defective genes. Drugs will not only alleviate these individuals' conditions, but in many cases they will also allow them to live long enough and be well enough in order to reproduce and, thus, keep their genetic material in the future human gene pool. Again, we are actively involved in shaping the genomes of next generations through methods that are usually left uncontested. Daniel

[87] J.A. Nell, I.R. Smith, A. K. Sheridan, "Third generation evaluation of Sydney rock oyster *Saccostrea commercialis* (Iredale and Roughley) breeding lines", *Aquaculture* 170 (1999): 195-203.

Koshland captures this view very well in the following paragraph:

> We are already altering the germline right and left. When we give insulin to a diabetic who then goes on to have children, we are increasing the number of defective genes in the population. No one is seriously suggesting we refuse to give life-saving drugs to genetically disadvantaged people. We attempt to treat cystic fibrosis, yet we are damaging the germline every day by doing so.[88]

Third, there are those who argue that germline engineering, through its inheritability, is similar to many instances of social engineering.[89] Furthermore, the social environment and its culture may affect both humans' phenotype, as well as genotype. A very trivial example linked to this thought is the way in which a culture's ideal of beauty relates to mate choosing and, consequently, to which genes are to be spread. Similarly, cultural norms regarding adultery may increase or decrease the number of offspring, which may increase or decrease the diversity of the gene pool. To return to a previously used example, namely that of lactose tolerance, lactose digestion has co-evolved with a culture of pastoralists.[90] In this last case, the environmental input had quite an impact on which genes were to survive and be transmitted to the next generations. Thus, pastoralism and its associated lifestyle can be considered as an active promoter of germline engineering. The evolution of human morphology is another area which has been heavily touched by cultural factors.[91] In this sense, technologically advanced societies can contribute to a reduction in the shape and body size of

[88]Daniel Koshland, Jr., "Ethics and Safety" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 26.

[89]Alex Mauron in "The Road Ahead. A Panel Discussion" in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 117-118: "A frightening new technological gimmick has been terrorizing people for quite some time. It provides a method for manipulating individuals by actually changing the connection between their brain cells! Furthermore, people whose brain structure has been altered in this way go on to produce similar neuronal changes in other people, so that these alterations resonate through successive generations and infect ever-increasing numbers of helpless humans. People promoting this dreadful technological monstrosity claim that, in the long run, people will be "better off" with engineered brains. Now there you see the typical hubris of the scientist-technocrat. He is blind to the long-term effects of this irreversible interference with the natural order. Society is held hostage to this technological utopia. Future generations as much as present-day society are the nonconsenting victims of his supposedly benevolent intrusions. Therefore: hands off from our neurons! This awful technology is called neuronal phenotype manipulation, a.k.a. education."

[90]Peter J. Richerson and Robert Boyd, *Not by Genes Alone: How Culture Transformed Human Evolution* (Chicago: University of Chicago Press, 2006): 192.

[91]P. J. Richerson and R. Boyd, op. cit., p. 193.

humans, as strength does no longer represent a reliable fitness indicator. Under these conditions, the germline of future generations is affected, given that technology allows people who would not otherwise have significant chances of reproduction to have offspring by making them more appealing or reducing the appeal of the rest.

Against this background, characterized by these three situations, it would be futile and unreasonable to oppose gene therapies targeting the germline, as the germline is already undergoing constant modifications. Basically, everything we do and everything that we abstain from doing influences the future and the people that are going to live in the future. In spite of the veracity of all these claims, it is salient to stress that most of the actions that we undertake, as the current generation, are not performed with the aim of benefitting or harming future generations. We live the way in which we live due to the constraints imposed by the present times and, if there is one major interest that is taken into account, it is not that of the yet unborn individuals, but of those that are alive at this very moment. Thus, most of our actions, projects and aspirations are implemented as a response to current needs. They are part of the normal flow of any human society and denying them would result in harming the present people. As our communities flourish economically, scientifically and technologically, our needs receive greater satisfaction and, in this way, we can start taking into account more seriously the interests of others, such as those of the future generations. Nonetheless, to deny treatment to current patients or to impose cultural and social stagnation in order to avoid radical germline changes would result in harming the present people, which is morally wrong and could not be justified by appealing to considerations regarding the well-being of future generations. From a different perspective, this course of events could not benefit the future generations themselves, once in existence, because they will be born with a cultural inheritance favoring stagnation and a sanctified protection of the human genome and individual germlines, such that their lives will not be as happy as they might have been otherwise.

The manipulation of the human germline through prenatal testing, embryo selection and selective abortion constitutes yet another means of ensuring that harm is avoided with respect to other future people, who exist now as embryos and fetuses. There are many types of painful and undesirable medical conditions nowadays for which there is no available treatment. Moreover, many of these conditions have been considered, in bioethics committees or courts of justice, to represent instances of wrongful lives, of lives not worth living. In these unfortunate cases, the elimination of the harmful effects of these diseases may only amount to the elimination of the conditions themselves, which could be realized through prenatal genetic testing. Thus, although prenatal screening and the rest of its accompanying procedures result in a manipulation of the germline, the lack of alternative in preventing serious harm and intolerable pain to the people that were to be born with certain diseases justifies their use. Also, it is worth emphasizing that the kind of germline intervention that is associated with embryo selection and selective abortion is far from the type of germline procedure that could have a big impact on the diversity of the human gene pool. In this sense, embryo selection and selective abortion can be considered bulk interventions that cannot allow for the existence of genuine designer babies or of baby designers. Selective abortion represents an instance of consent or lack thereof. It is a 'yes/no' type of question, which does indeed take as an input the genetic material of the future baby, but which cannot proceed to its exact configuration. On the other hand, embryo selection can guarantee more choosing options. It does not only rest on a 'yes' or a 'no', but it still cannot support a decision regarding many of the genes that the future baby will have. Finally, embryo selection and selective abortion, as they are currently used, are negative rather than positive procedures. They do not aim at enhancing the genetic material of an embryo or fetus. Their intended purpose is restricted to the prevention of disease and disability. In some cases, selective abortion and certain steps taken during the IVF process can also be regarded as tools for choosing the gender of the future baby. However, this issue is not directly

linked to the question of genetics and germline manipulation because it does not aim at selecting a baby for her genes, but for her gender. It is rather a social problem, whose roots can be found in the prevailing attitudes and moral sentiments.

Thus, so far, it seems that this objection against my argument regarding genetic diversity and germline interventions, which is based on the fact that humans have always influenced the genes of the future people and still continue to do so, can be adequately answered. First, whatever we do or do not do has an impact on the future and, consequently, on the genetic material of the people living in the future. Second, some forms of germline manipulation that we are using nowadays, like embryo selection and selective abortion, are employed for very limited purposes, only as negative interventions, with a goal that can justify them - namely, that of preventing harm -, and with no other alternative that could replace them. As I have previously stated, maintaining the diversity of the germline is not required as a good in itself, but as a means to prevent harm. As such, whenever this value conflicts with another one, which, at its turn, has the same harm avoiding goals, then priority should be given to the most stringent. In the case of embryo selection and selective abortion, the immediate harm inflicted on the child born in 9 months outweighs the harm of a reduced gene pool that could be felt by the future generations. In the eventuality in which these two prenatal procedures could be replaced by somatic gene therapy, then they cease to be justified and the protection of the gene pool diversity should prevail.

5. Objection 5: intentional pursuit of genetic diversity through germline engineering

If genetic diversity is so beneficial, then why could we not employ germline therapies in such a way as to achieve just that: genetic diversity accompanied by heterozygosity? The problem with this view is that it expects parents, the actual decision-makers when it comes to germline procedures, to care more about genotype than phenotype and to include in their reasoning process factors other

than their children's well-being. If the necessary technology to achieve both of these ends – healthy phenotype and heterozygous genotype – exists, then there is no problem. However, chances are that genetic technologies will develop incrementally and, at least in their incipient phase, they will not be able to accomplish both of these goals.

6. Objection 6: harm reduction potential

Finally, one could object to my argument regarding germline interventions, genetic diversity and future generations by relying on the harm reduction potential of germline procedures, which has already been addressed in the previous paragraphs, and by emphasizing the fact that they may bring advantages to those who will be born without certain genetic conditions. Although this is true, we should not disregard the risks posed to the gene pool by germline manipulations. Thus, if a certain procedure is beneficial in a way, risky in another, and, moreover, could also be replaced by a less hazardous alternative, then it would be rational to prefer the alternative. Fortunately, there are alternatives to germline interventions that could be developed and used in their stead, such as somatic therapy, even in utero somatic therapy after the mid trimester which could successfully avoid the occurrence of inadvertent germline gene transfer.

Also, there is the possibility of re-conceptualizing the notion of germline engineering: from a type of genetic modification that will necessarily affect the genomes of an entire line of descendants to a genetic intervention whose expression could be controlled. In this sense, there is the possibility of altering the germline, but without automatically spreading the changes to all descendants. This could be done by introducing an artificial chromosome, which is engineered to be non-inheritable after a certain generation. As Campbell and Stock rightly point out, 'Chromosomes

could be blocked in a variety of ways from passing through the sexual cycle to the next generation.'[92]

Ultimately, my concern is not about germline modifications as such, but about making some genetic changes indiscriminately heritable. If germline interventions may be designed in such a way that their heritability may be controlled, then I argue that then there would be no successful ground for opposing them.

[92] John Campbell and Gregory Stock, "A Vision for Practical Germline Engineering' in John Campbell and Gregory Stock (eds.), *Engineering the Human Germline: An Exploration of the Science and Ethics of Altering the Genes we Pass to our Children* (NY: Oxford University Press, 2000): 11.

CHAPTER 3

Human Enhancement: Definition, Limits and Classification

Now, here, you see, it takes all the running
you can do, to keep in the same place.
(L. Carroll)

If I were to travel back in time, the last thing I would consider taking along would be an IQ test. But perhaps this wouldn't be such a bad idea, after all. Surprisingly or not, the average American living in 1900 would only score 67 points on one of our present intelligence tests. Ten years later, in 1910, the mean IQ in the United States would increase by 3 points, thus up to 70, again, as measured against our current standards. However, if we were to assess our own IQs based on our previous generations' tests, we would get a staggering average value of 130 or 140, depending on how far back we would stretch.[93] What does this all mean? As an IQ below 70 is usually labeled as an intellectual disability and one of 130 and above as 'very superior,'[94] it seems very hard to believe that most of us are geniuses and super-geniuses - in the case in which we score above the mean -, while our predecessors were excluded even from the borderline average.

A glimpse into the roots of this disparity may be offered by the so-called 'Flynn effect'. According to James R. Flynn, there is a constant increase in the human IQ, which is noticeable from generation to generation. The reason for this enhanced intelligence lies simply in the infrastructure

[93] James R. Flynn, *Are we Getting Smarter? Rising IQ in the Twenty-First Century* (Cambridge: Cambridge University Press, 2012).
[94] Dawn P. Flanagan and Alan S. Kaufman, *Essentials of WISC-IV Assessment (Essentials of Psychological Assessment)* (John Wiley & Sons: 2009).

of normal daily life, which has become over the years more cognitively stimulating and demanding. The development of different technologies and the need to understand and use them, together with the widespread and greater length of school education have transformed the human reasoning process in a crucial way, by encouraging it to rely less on the concrete and choose to embrace the hypothetical and the abstract as well.[95] Improvements in nutrition, hygiene, even the rendering into routine of Caesarian sections, which allow babies with larger skulls to be born, are also part of the conundrum of variables accounting for the continuous development of human intelligence.

One of the major implications of the Flynn effect for bioethics is that of showing how widespread enhancement is and, moreover, how tightly it is linked to the mere process of survival. In this sense, the history of human evolution abounds in examples of beneficial trait selection, like, for instance, bipedalism. We ourselves are fine products of a series of uncountable enhancements and are far from constituting its end point. The same goes for other organisms, be them bacteria, viruses or mammals. This said, I would like to rely on the Flynn effect while introducing the two most significant assumptions on which the next three chapters of this dissertation are built:

1. Enhancement is not only man driven, but it also occurs spontaneously in nature.
2. In some cases, enhancement is necessary for species adaptation.

The aim of this part is to clarify the concept of human enhancement, by focusing on its meaning, its limits as determined by its position on the medical services' axis, and, finally, the many forms under which we may encounter it. These topics will partially set the ground for discussing, in other chapters, the way in which human genetic enhancement may affect the potential interests and well-being of future generations.

[95] J. R. Flynn, op. cit.

1. What is human enhancement and where is it placed in the medical repertoire?

Oxford Dictionary defines enhancement as 'an increase or improvement in quality, value, or extent.'[96] But does any increase or improvement of this sort count as an enhancement or is it perceived as such within the medical tradition? In order to tackle this question, I propose two thought experiments, which are not that far-fetched from everyday reality.

Walter, an otherwise healthy middle aged man, is struggling with a high level of lipids in his bloodstream. After a visit to his physician's office, he is advised to take statin drugs in order to block the production of cholesterol in the liver. The statins are efficient and not only is Walter's lipid count lowered, but his cardiovascular function is also generally improved. As we are witnessing here an increase in quality, namely, that of the cardiovascular system, the next question to ask is: does this constitute an enhancement? Intuitively, I will say no. The situation depicted here bears a great resemblance with, unfortunately, a quite widespread practice nowadays: the *treatment* of high cholesterol.

Let us now turn to the second thought experiment. Evelyn is an Anthropology graduate student with a family history of diabetes, which puts her at risk for developing this condition later on in her life. Evelyn's doctor is a strong believer in the influence of the environment on gene expression and, as such, warmly encourages his patient to undergo a lifestyle change by adopting a healthier diet, lose 10% of her body mass, and engage into regular physical exercise. Evelyn bears a lot of respect to her physician and is thus keen on immediately following his guidelines. After a couple of months, Evelyn's general health starts showing signs of improvement, although Evelyn has never been diagnosed with an illness or disability. Among other changes, her general inflammation marker decreases by 1.6, from 2.5 to 0.9,[97] while her body mass index lowers from 25

[96] Oxford Dictionary, available online at http://www.oxforddictionaries.com/definition/english/enhancement?q=enhancement Last accessed: October 2013.

[97] The C-Reactive Protein (CRP) is a general inflammation marker. Its normal range should be situated below 3 and 0 is

to 23.[98] These results indicate that diabetes will be much delayed, if it will ever occur. Similarly to the previous scenario, we are witnessing an upgrade in Evelyn's physical health. Is this upgrade, nonetheless, sufficient to characterize it as a medical enhancement? Again, by relying on intuition, the answer is no. The reason for this is very simple: Evelyn's lifestyle change is meant to treat a yet non-existing but highly probable future illness. The term that would best describe such an endeavor would not be enhancement, but rather *prevention*.

What do the two thought experiments show us with respect to the definition and position of enhancement within the medical practice? In order to characterize something as enhancement, not only the improvement component matters, but we should also look at the starting and end points of the procedure. In the first scenario, we departed from an imperfect state of health, as defined by the current standards, and through medical intervention we reached some improvement. In the second case, we started from a good state of health and through medical intervention we could at best achieve its continuation. As such, in order to properly define enhancement, we should identify those procedures that evolve from good to better (Please see Fig. 2). This latter type of interventions are unlikely to be necessary for a satisfactory health condition, although good health does constitute their starting point. Nonetheless, their aim is to move beyond it and to attain advantages whose relevance is not circumscribed to health and health care. Better visual acuity, improved hearing, upgraded memory or the ability to run faster do not determine whether we are healthy or not. However, they do bring benefits of another nature, by helping us in our professional environment or in the way in which we relate to other people and to ourselves. Shortly put, what these points are meant to emphasize is that enhancement does not relate to one's health[99] status and, as such, it is

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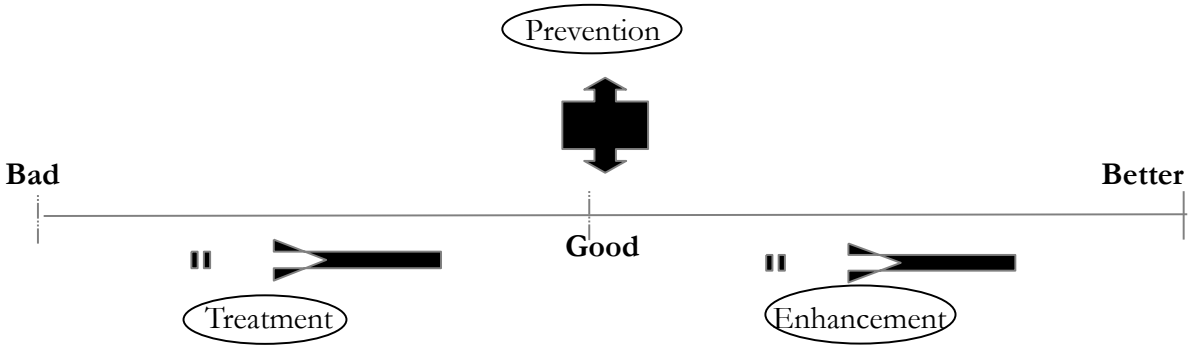
the optimal value.

[98] The Body Mass Index (BMI) measures the relation between one's person's body weight and height. Its normal range stretches from 18.5 to 25. Lower BMIs are correlated with several health benefits. (Matthias Bluher, Barbara B. Kahn, C. Ronald Kahn, "Extended Longevity in Mice Lacking the Insulin Receptor in Adipose Tissue", *Science* 24 January (2003), Vol. 299, No. 5606, pp. 572-574.)

[99] Unless otherwise specified, I define 'health' here and in the remainder of the thesis as a state of good bodily

dispensable to it.

Fig. 2: The demarcation between treatment, prevention, and enhancement according to their starting and end points



The relationship between enhancement, treatment and prevention is not without problems of its own. Let us have a closer look at the first two. We may notice that the demarcation line between treatment and enhancement is rarely left uncontested by the literature. Walter's situation, for instance, would almost unequivocally be regarded by medical practitioners and bioethicists as a clear example of treatment. But, unfortunately, many real cases are not as easy to sort out as this. Difficulties related to the correct identification and the conceptual separation of enhancement and treatment may arise in quite a few number of contexts. One such example would be phenotypic similarity within genotypic variation. What does this amount to? Briefly put, a certain phenotype may constitute, in some people, a symptom of a disease or disability, while, in others, it is simply the

functioning, associated with physical and mental well-being.

result of their genetic inheritance and it's associated with a good, disease-free state of health. At the beginning of the 90s, Allen and Fost described one such scenario, which, in spite of being more than 20 years old, still continues to be relevant for the treatment/enhancement debate.

> Johnny is a short 11-year-old boy with documented growth hormone (GH) deficiency resulting from a brain tumor. His parents are of average height. His predicted adult height without GH treatment is approximately 160 cm (5 feet 3 inches).
> Billy is a short n-year-old boy with normal GH secretion according to current testing methods. However, his parents are extremely short, and he has a predicted adult height of 160 cm (5 feet 3 inches).[100]

Now, although Johnny's phenotype is identical to Billy's, Johnny's growth hormone therapy would constitute medical treatment, whereas the same intervention in Billy's case would be regarded as enhancement. This is, at least, what my definitions of treatment and enhancement, as medical procedures, would stipulate. However, this conclusion seems to go against logic, as we are treating differently cases that are similar. One significant question is worth raising here, though: how similar are Johnny and Billy's situations anyway? Unlike Billy, Johnny suffers from actual growth hormone deficiency. This condition is not only characterized by short stature, but also by other serious manifestations, ranging from pituitary hemorrhage to impaired cardiac function, and even premature mortality.[101] Billy, on the other hand, is affected by none of these other symptoms. As such, their cases do not perfectly overlap. One might even argue that Johnny's therapy is not targeting short stature itself, but rather growth hormone deficiency, together with all its accompanying features. It would ultimately be incorrect to confuse this latter condition with short stature because it implies much more than that.

The problem with Allen and Fost's example is that it is presented in an ambiguous way due to the fact that it substitutes one constitutive element for the whole. Their attempt could be even

[100] David B. Allen and Norm Fost, "Growth Hormone Therapy for Short Stature: Panacea or Pandora's Box?", *Journal of Pediatrics* 117 (1990): 16-21.

[101] For a complete overview of the clinical symptoms of growth hormone deficiency, please see Vishal Gupta, "Adult Growth Hormone Deficiency", *Indian Journal of Endocrinology and Metabolism* 15 (September 2011): 197-202.

referred to as disease mongering by trying to medicalize the non-pathological. Short stature in itself is not regarded as a disease or disability by the medical practice, whereas growth hormone deficiency is. If we analyzed Johnny and Billy's case from this perspective, it would not seem illogical anymore to characterize the same therapy as enhancement, for one, and treatment, for the other. Fortunately, this example could be generalized to other cases as well. As such, I argue that, when dealing with phenotypic similarity within genotypic variation, treatment can be conceptually separated from enhancement. The reason for this is that, in one case (as in that of Billy's), a phenotypic trait is isolated and brings no impairment on the functioning and general well-being of its bearer, while in in the other it is accompanied by several other health damaging traits with which it shares the same genotypic origin (as in Johnny's example).

If the first type of problem that attempts at effacing the dividing line between treatment and enhancement can be solved, there is another significant issue that aims toward the same target. Its proponents usually argue by adhering to the following reasoning pattern. Suppose that enhancements become not only extremely diverse - increasing in both the number of objects to which they apply and in the means that they employ -, but also very efficient and widespread. In fact, their usage is so common that each person has underwent an improving procedure at least once throughout their life. Now, the very fact that enhancements are so pervasive pushes the boundaries of normalcy beyond what had been previously established. If a 20/20 ratio used to be considered an average, good enough indicator of visual acuity in the past, it turns out that after a couple of rounds of enhancements most people have managed to surpass that value. They routinely score now 20/10 or even 20/8. In this context, should the limits of eyesight normalcy be redrawn? Should 20/20 be regarded as a symptom of blurred vision and not a mean value, while a medical intervention that takes one from 20/20 to 20/10 or even to 20/8 be considered treatment rather than what we had previously characterized as enhancement? Basically, this line of argumentation depicts a conceptual

arms race between treatment and enhancement, which is constantly fueled by new technological discoveries and an increased availability of upgrading tools. Thus, every *n* number of years or every *n*th generation, there would be a need to reevaluate the normal distribution of human traits. Moreover, according to Kurzweil's Law of Accelerating Returns, 'technological change is exponential, contrary to the common-sense <intuitive linear> view.'[102] This means that re-conceptualizing human normalcy would become more and more frequent, paralleling the speed of technological innovation.

Is this type of criticism an insurmountable obstacle for the integrity and very existence of a dividing line between treatment and enhancement? I argue that it is not. In my answer, I rely on the fact that we have already been exposed to certain types of enhancements for quite a long time and this has not radically impacted our standards regarding the human body. Take rhinoplasty, for example. According to the Edwin Smith Papyrus, mentions of rhinoplasty date as far back as 3000-2500 BC. However, the first modern rhinoplasty was performed in the US in the 19th century.[103] After almost 200 years in which this surgical procedure underwent further exploration, improvement, increased popularity and reduced costs and risks, the number of people that currently resort to it is not particularly high. In 2012, in the US, out of a total population of 313,933,954[104], only 40,298[105] – which represents 0.12% - chose to have a cosmetic rhinoplasty. This figure is even more paradoxical as, according to a highly quoted survey regarding the body image of US women, '[n]early one half of the women reported globally negative evaluations of their appearance.'[106]

[102] Ray Kurzweil, *The Law of Accelerating Returns* (March, 2001), available at http://www.kurzweilai.net/the-law-of-accelerating-returns Last accessed: November 2013.

[103] Melvin A. Shiffman, "History of Cosmetic Surgery" in Melvin A. Shiffman and Alberto di Giuseppe (eds.), *Cosmetic Surgery: Art and Techniques* (Springer, 2012): 20.

[104] The United States Census Bureau website, available at http://www.census.gov/popclock/ Last accessed: November 2013.

[105]The American Academy of Facial Plastic and Reconstructive Surgery website, available at http://www.aafprs.org/media/stats_polls/m_stats.html Last accessed: November 2013.

[106] Thomas F. Cash and Patricia E. Henry, "Women's Body Images: The Results of a National Survey in the USA", *Sex Roles,* vol. 33, No. 1 /2 (1995): 19.

Unfortunately, there is no survey that deals specifically with women's attitude toward their facial features, among which the shape and size of the nose usually count as prominent evaluation criteria. Nonetheless, in the absence of such direct evidence, a report on body image can be a quite reliable next best thing.

What the example of rhinoplasty shows is that even if a certain medical service or procedure has been available for a long period of time, this does not necessarily mean that (1) people will automatically choose to use it, even if they value the type of advantage that it confers; or that (2) they will change the category in which they integrate the service. Rhinoplasties performed for purely aesthetic reasons are still considered enhancements and not treatments,[107] while having a perfect nose has not yet become a standard of human normalcy.

One difficult case to which I need to respond in order to fully defend the conceptual distinction between treatment and enhancement against the idea that the evolution of the latter dissolves the boundaries of the former resides in the very opening lines of this chapter. More precisely, it is the Flynn effect. As previously stated, the Flynn effect shows how human IQs improve constantly, from generation to generation. Furthermore, it notes how our intelligence tests have evolved and increased in difficulty in order to cope with this raise. Thus, although we have not changed the figures themselves (70 is still associated with an intellectual disability), we have modified the assessment procedure. Consequently, it would not be incorrect to claim that we have raised the boundaries of the human average IQ values. Although this example poses quite a challenge to my defense, I believe it can still be answered. The Flynn effect does testify to the existence of an enhancement and, on top of this, one that changes the way in which we perceive the defining characteristics of humans. But unlike the enhancements that we are used to discuss about in the bioethics literature and which are intentional and man-driven, this one is an improvement embedded

[107] There are some rhinoplasties that deal with nasal trauma or nasal congenital defects, but my focus here is on aesthetic rhinoplasties.

in human evolution itself that one cannot directly accept or refuse[108] and whose root cause defies any attempt at decomposition due to the fact that it results out of a highly intertwined mixture of factors. As this IQ upgrade evades any type of individual control, I would suggest that it represents a particular type of enhancement. It is still an enhancement, nonetheless, which is why I am going to circumscribe my defense of the treatment/enhancement distinction to the category of intentional, direct, man-driven, individually controlled enhancement. Given that these procedures are the ones that spark the biggest controversies, I believe that showing that they can be conceptually separated from treatments is not a trivial matter.

A second issue related to boundary demarcation is worthy of our attention. This time, the key figures are enhancement and prevention. Similarly to the treatment/enhancement debate, we can easily notice that the limits of their domains get blurred, as opinions fluctuate and conflict. Bostrom and Roache summarize this situation very accurately in the following extract:

> [i]t is unclear how to classify interventions that reduce the probability of disease and death. Vaccination can be seen as an immune system enhancement or, alternatively, as a preventative therapeutic intervention. Similarly, an intervention to slow the aging process could be regarded either as an enhancement of healthspan or as a preventative therapeutic intervention that reduces the risk of illness and disability.[109]

Let us now take a closer look at a concrete example, namely, that of immunization, and notice how the prevention/enhancement discourse is shaped around it. Thus, according to one view:

> In current medical practice, the best example of a widely accepted health-related physical enhancement is immunization against infectious disease.
> With immunization against diseases like polio or hepatitis B, what we are saying is in effect, "The immune system that we inherited from our parents may not be adequate to ward off certain viruses if we are exposed to them." Therefore, we will enhance the capabilities of our immune system by priming it to fight against these viruses.[110]

[108] Even those groups that do not want to embrace the use of new technologies, as in the case of the Amish, are touched by the Flynn effect through other different factors, like better nutrition.

[109] Nick Bostrom and Rebecca Roache, "Ethical Issues in Human Enhancement" in Jesper Ryberg, Thomas Petersen and Clark Wolf (eds.), *New Waves in Applied Ethics* (Pelgrave Macmillan, 2008): 120.

[110] Leroy Walters and Julie Gage Palmer, *The Ethics of Human Gene Therapy* (New York: Oxford University Press, 1997): 110.

A contrasting reasoning line could be presented as follows:

> Prevention is said to have three components: primary, secondary and tertiary. Primary prevention means preventing the occurrence of disease or injury, for example, by immunization against infectious diseases and by the use of safety equipment to protect workers in hazardous occupations. Secondary prevention means early detection and intervention, preferably before the condition is clinically apparent, and has the aim of reversing, halting or at least retarding the progress of a condition. Secondary prevention is epitomized in screening programs in which people with early, often preclinical manifestations of disease are identified and offered a regimen to prevent its progression. Tertiary progression means minimizing the effects of disease and disability by surveillance and maintenance aimed at preventing complications and premature deterioration.[111]

There are strong grounds on which one could argue that immunization is a form of enhancement. Ultimately, routine vaccinations do instruct the immune system to fight pathogens in a way in which it would not normally react, at least, in most people. But is this improvement of different immune capabilities sufficient to define it as an enhancement? Again, I will rely on the previously mentioned progress axis in order to elucidate this matter. When undergoing immunizations of different sorts, our bodies are in a good health condition, in the sense that they are not already infected with the organisms that the vaccination is meant to counteract. Unless this latter constraint is met, the immunization procedure cannot even take place. Briefly put, then, our departure point in this example is a good state of health due to the absence of infectious diseases. After vaccination, the good health parameters are still maintained, but there is no upgrade to better than good. As such, the pre-immunization health condition is identical to the post-immunization one. Needless to say, this constitutes an outcome that one would not expect after an enhancing procedure.

Vaccinations probably constitute the blurriest territory in the enhancement/prevention debate. I have tried to show that there is a more compelling reason to consider them preventive

[111] J. Last, "Scope and Methods of Prevention" in J. Last (ed.), *Public Health and Preventive Medicine*, 12th ed. (New York: Appleton-Century Crofts, 1986): 3.

rather than enhancing. Nonetheless, there are other real life examples that are not as controversial as this. One such good illustration would be Evelyn's story, which was presented earlier in this chapter. Perhaps it makes no moral difference whether a certain medical intervention can be characterized as enhancement or prevention. At least, I am not trying to make a case for it here. What I am trying to argue is that they constitute two different concepts, which may overlap[112] but can still be distinguished from each other.

In order to properly localize the place of enhancement within the medical practice and the bioethics literature, one needs to clarify a further source of confusion. In these two areas, namely, medicine and bioethics, enhancement is usually circumscribed to and discussed in reference to humans. This does not mean that non-human enhancement is not considered, but it occupies a far less central role than the human one. In spite of this, there are cases when the literature conflates the human and the non-human types of enhancement and uses the latter's widespread and social acceptance as a sort of justification for pursuing the former. Cognition is probably the most preferred area for drawing such a parallel. Here are some examples to illustrate this point.

> Cognitive enhancement may be defined as the amplification or extension of core capacities of the mind through improvement or augmentation of internal or external information processing systems. As cognitive neuroscience has advanced, the list of prospective internal, biological enhancements has steadily expanded (Farah et al. 2004). Yet to date, it is progress in computing and information technology that has produced the most dramatic advances in the ability to process information. External hardware and software supports now routinely give human beings effective cognitive abilities that in many respects far outstrip those of biological brains.[113]

> The spectrum of cognitive enhancements includes not only medical interventions, but also psychological interventions (such as learned "tricks" or mental strategies), as well as improvements of external technological and institutional structures that support cognition. A distinguishing feature of cognitive enhancements, however, is that they improve core cognitive capacities rather than merely particular narrowly defined skills or domain-specific knowledge.[114]

[112]For instance, one may think of a medical procedure that fulfills two aims: to prevent shortsightedness and to enhance vision beyond the 20/20 value.

[113] Nick Bostrom and Anders Sandberg, "Cognitive Enhancement: Methods, Ethics, Regulatory Challenges", *Science and Engineering Ethics*, 15 (2009): 311-312.

[114] N. Bostrom and A. Sandberg, op. cit., p. 312.

> The productivity effects of computers and information technology in industry have been widely studied and found to be positive and nontrivial (Brynjolfsson & Hitt, 1998; Brynjolfsson & Yang, 1996; Stiroh, 2001). Given that the productivity increase appears to be a sizable part of the total factor productivity (Fernald & Ramnath 2003) and that GDP growth appears to track productivity growth this means that the economic gains from IT technology in the U.S. economy would be on the order of a few hundred billion dollars each year. Part of this gain would be due to the cognition-enhancing abilities of software. Arguably, a significant proportion of increase in GDP over recent years has been the result of external cognitive enhancement: the computing and IT revolutions.[115]

The excerpts that I have just presented indicate a position that does not pay much consideration to the object of enhancement, as long as an increase in quality occurs, and prefers to gather all improvements under the same conceptual umbrella, namely, that of cognitive enhancements. What it is not clear in the above paragraphs is to what or to whom the cognitive upgrade is applied. To put it differently, whose quality improvement are we talking about? Is it the quality of a human function or capability? (In this specific case, we are referring to the cognitive function, but this discussion could be extended to the physical and moral human capabilities as well.) Or is it the quality of an end product of such a function? Although, at a first glance, the distinction between the enhancement of human capabilities, on the one hand, and of their end products, on the other, may seem irrelevant, I believe that it is of great significance for the very reason that in many cases they cannot coexist. And this is precisely what the position that I am trying to refute is arguing for. In Bostrom and Sandberg's words, '[e]xternal hardware and software supports now routinely give human beings effective cognitive abilities.'[116] According to this view, since we already have external technological aids for our cognition, it should make no noticeable difference whether we enhanced ourselves medically or genetically. This reasoning line seems to be a *non sequitur* due to the fact that it ignores the distinction between the improvement in human capabilities and that of their end products, which normally – though not always - matches the distinction between external and

[115] Anders Sandberg and Julian Savulescu, 'The Social and Economic Impacts of Cognitive Enhancement' in Guy Kahane, Julian Savulescu and Ruud ter Meulen (eds.), *Enhancing Human Capacities* (Wiley-Blackwell, 2011).
[116] N. Bostrom and A. Sandberg, op. cit., p. 312.

internal enhancements. More importantly, it overlooks the fact that they might go into separate ways.

I would like to use an example in order to illustrate this latter idea. It is that of mobile phones. Mobile phones represent a technology that we are more than used to. It is many times argued that they have managed to enhance our memories due to the fact that they generously offer their own memory capacity to store all the telephone numbers that we know and might need. But is it really the case that mobile phones improved *our* memory? I doubt that most of us can remember the top three most frequently used numbers if they are dialed exclusively from a mobile phone. The reason for this lack of knowledge is quite simple: we do not need to memorize them in order to make a phone call. What we do instead when we want to call somebody is search for a name, press a button, and wait for the phone to ring. Now, it would be difficult to characterize all this process as an improvement of the *human* memory because we have not actually made use of it. But it is an improvement in the way in which we complete a task that is dependent on memory. The results of this technology are fantastic: the storage of loads of random strings of numbers that connect us with specific people is no trivial betterment of one's life. Nonetheless, despite the fact that the end results of our mnestic function are extraordinary, our function itself has deteriorated. It would be no false generalization to say that prior to the widespread use of mobile phones, we did know by heart the most frequently dialed number(s).

I hope this example is illustrative of the distinction between the enhancement of human capabilities and that of the end products of these capabilities. It seems that, at least in some cases, the former does not coincide with the latter. As such, it is not useful, nor accurate, to refer to all sorts of technological devices as instances of human enhancement, although they can indeed enhance processes, procedures and results.

Following a similar line, it's important to emphasize that the enhancement of a particular human capacity need not necessarily overlap with a systemic, overall improvement of an individual

or of her well-being. We shouldn't be surprised if, after considering all the effects brought by an enhancing intervention, we realize that we are left worse off or, at least, not better than we were prior to the modification. Allen Buchanan offers a very good example to illustrate this point: 'if your hearing were greatly enhanced, it might not improve your life. It might make you miserable, because you might not be able to concentrate due to all the noise.'[117] As such, Buchanan argues that we should give up talking about the enhancement of people and start referring instead to the enhancement of human capacities. I believe this is a very accurate observation that can cast further light into the essential characteristics of enhancements.

So, what thoughts related to human enhancement can we keep from this section? Briefly put, I have argued that human enhancement is:

a) an improvement that is dependent upon its starting and end points in such a way that it needs to evolve from good – or normal - to better;

b) an improvement that is dispensable to a good state of health;

c) an improvement of a human capacity and not solely an upgrade in task completion;

d) an improvement of a human capacity that does not necessarily coincide with an overall, systemic upgrade.

As goodness or normality constitutes a crucial benchmark against the conceptual and practical delimitation of human enhancement, my account can only be complete only after establishing what normality represents in biology and the other life sciences. This is the aim of the next section.

2. Normality in biology and the life sciences: Arguing in favor of the pure state account

[117] Allen Buchanan, *Better than Human: The Promise and Perils of Biomedical Enhancement* (NY: Oxford University Press, 2011): 6.

There are three main accounts of biological normality in bioethics, the philosophy of medicine and distributive justice in health and health care, namely: statistical, etiological and social. The statistical model, supported by Boorse and Daniels, is centered on the idea that one can identify normality with respect to health by looking at one specific measure of central tendency – mean, median or mode – within a certain distribution that is constructed on the basis of age, race and sex categories. According to this view, disease and disability are perceived as impairments or adverse departures from 'normal species functioning.'[118]

On the other hand, the etiological model is based on the concept of function and defines normality and abnormality by evaluating the way in which a certain bodily part fulfills the role that evolution assigned to it. For instance, the heart's role in the body is to pump blood. If a heart performs well in this regard, then it is a normal, functioning heart. If it does not, it is abnormal and malfunctioning.[119]

Lastly, the social or evaluative model states that normality and abnormality, which roughly correspond to health and disability, are defined according to the input that is received from society through various conventional, cultural and institutional norms.[120] As such, a certain trait or function is abnormal not only because a minority of the population has it, nor because it fails to fulfill its evolutionarily assigned role, but rather due to the fact that the social framework of cooperation is set up in such a way as to disadvantage that particular characteristic. Consequently, according to the evaluative account, one trait could constitute an abnormality or disability in one social environment, but not in other(s). This idea is very well captured by the authors of *From Chance to Choice:*

> This sort of cooperative scheme, which for convenience we can call "the industrial-symbolic economy," requires individuals to have a complex array of literacy and numeracy skills if they are to participate effectively in it. These skills may not be needed to thrive in other, "developing" societies,

[118]Norman Daniels, *Just Health Care* (Cambridge: Cambridge University Press, 1985): 26.
[119]The example of the heart's function in pumping blood is also offered by Robert Wachbroit in "Normality as a Biological Concept", *Philosophy of Science,* Vol. 61, No. 4 (Dec. 1994): 584-585.
[120]R. Wachbroit, op. cit., p. 580.

> where the division of labor is not so elaborate, where contractual relations and interactions over large distances and across long stretches of time are not so common, and where communication is exclusively oral. Accordingly, some individuals may be disabled in our society, but not in others.[121]

The three accounts of normality presented above do not necessarily conflict, but they do not necessarily converge either. In spite of the valuable arguments that each of them puts forward, they are ultimately incapable of providing a sound and coherent guide for a theory and practice of a just distribution of health resources. I will present the most compelling objections that can be brought against each of them in the following lines.

(*1) Objections against the statistical model*

The first problem associated with the statistical model, at least in the version developed by Boorse and employed by Daniels, is that it is prone to circularity. This circularity is evident if we look at its choice of reference points, namely, age, sex and race. In an article criticizing Boorse's model, Kingma asks why those particular classes are appropriate benchmarks for evaluating normality; why not also include blindness or pneumonia, for instance? If the reason for using age, sex and race as reference classes and not blindness or pneumonia is that 'the former are natural variations, while the latter are diseases', then the account is 'constructed based on some prior distinctions between health and disease.'[122] Consequently, it's circular and not as value-free as it pretends to be.

The second major problem to which the statistical account is prone is its inability to respond to changes, rapid or not, occurring in the distributional *status quo.* Suppose, for instance, that at a certain time during its evolution, most of the human population is infected with a virus that causes arrhythmia. In this case, does it mean that arrhythmia ceases to be a medical condition? As it

[121]Allen Buchanan, Dan Brock, Norman Daniels and Daniel Wikler, *From Chance to Choice* (New York: Cambridge University Press, 2009): 289.
[122] Elselijn Kingma, "What is it to be Healthy", *Analysis*, 67, no. 2 (2007): 129.

represents an impairment that one would rather not have due to its negative effects on well-being and life prospects, it would ultimately be an unsound conclusion to regard it as part of 'normal species functioning.'

Following the same line, there are real life situations in which the statistical model fails to appropriately distinguish diseased from disease-free states. One proper example is that of primary amyloidosis. As amyloid deposits continuously accumulate in our bodies since birth, more than 60% of primary amyloidosis patients belong to the 50-70 age group at the time of the diagnosis. Also,

> autopsy studies indicate that amyloidosis may be almost universal in elderly people (Blumenthal, 2002) and, in autopsies performed by the Supercentenarian Research Foundation (SRF), amyloidosis has been identified as the cause of death in about 70% of people over 110 years of age (Coles and Young, 2012).[123]

The implications of this case are staggering for the statistical model. According to it, amyloidosis would not constitute a disease for a person older than 50 at the time of the diagnosis. However, the same condition would pose a problem to the normal functioning of anyone younger than that. This counterintuitive and discriminatory conclusion renders the statistical model a poor tool for making meaningful distinctions and for guiding public policy in the field of health and health care. Medical practice and the actual distribution of health resources confirm this latter thought by allowing vulnerable populations, like the 50 and older in the case of primary amyloidosis, to receive publicly funded medical treatment and to have their condition recognized as impairment, rather than an instance of normality.

(*2) Objection against the etiological model*

The most important line of criticism that dismisses the etiological model on both theoretical

[123] Sven Bulterijs, Raphaella S. Hull, Victor C. E. Bjork, Avi G. Roy, "It is time to classify biological aging as a disease", *Frontiers in Genetics* 6: 205 (2015), published online at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4471741/ Last accessed: August 2015.

and practical grounds is focused on its ambiguity with respect to the distinction between functioning and malfunctioning traits. Wachbroit uses the example of sickle-cell anemia in order to highlight this idea.[124] Sickle-cell anemia results out of a point mutation that distorts the hemoglobin within blood cells and, in this way, negatively affects the transportation of oxygen into tissues. However, in its heterozygote state, this mutation offers protection against malaria. Now, the problem that the example of sickle-cell anemia poses for the etiological model consists in the fact that a certain condition, although defined as a malfunction, can still bring a benefit. '[F]rom a hematological point of view, the sickle mutation constitutes a malfunction, even though it might be said that the mutation has a function from an immunological point of view.'[125] Nonetheless, the absence of the sickle mutation and its associated lack of protection from malaria, is rarely – if ever - considered to be a malfunction. What follows from this discussion is that the etiological model is over-inclusive, providing evolutionary explanations not only for functioning, but also for malfunctioning traits.

(*3) Objections against the social/evaluative model*

Many critics of the evaluative model, including John Harris and Jonathan Glover, argue that normality and disability cannot be defined solely in terms of social conditions and social input. If this were the case, then the victims of systematic discrimination based on race, gender or ethnicity would count as disabled, alongside the deaf, blind or paraplegic communities. According to Harris, we need to ask ourselves the following set of questions, when assessing the validity of the social model and its ability to distinguish between health, disease and disability:

> [I]f all the social dimensions of disability could be resolved, there would be any other dimensions left and if so how important they would be? In particular would we have any reason to call these non-social, or "medical" dimensions, "disabilities" at all and would there be any reason left to alter these

[124] R. Wachbroit, op. cit., p. 585.
[125] R. Wachbroit, op. cit., p. 586.

factors if we could?[126]

Harris's concerns are brilliantly answered by Jonathan Glover: 'Robinson Crusoe, alone on his island and unable to walk properly after a stroke, would still be disabled.'[127]

The second objection that can be brought against the social model is again built on the latter's attitude toward impairment. This time, however, it is not related to the model's inability to distinguish between the specificities of different types of discrimination, but to its insensitivity toward the non-social components of disease and disability. In this sense, Tom Shakespeare and Nicholas Watson emphasize the fact that it may prove to be impossible to remove all the obstacles faced by disabled individuals due to the simple reason that 'some of them are inextricable aspects of impairment, not generated by the environment.'[128] Thus, one should not disregard the physical pain and discomfort that characterize many impairments and which are unfortunately neglected or, at best, minimalized by the evaluative model.

Finally, the internal inconsistency of the social model constitutes the core of the last objection that I will present against it. In as little as 20 or 30 years, many social values have changed and some have even undergone radical shifts. If normality, disease and disability are to be defined according to society's evaluations, then one can expect a great deal of oscillation with respect to what good health is in quite a short amount of time. For instance, political dissidents were considered mentally ill by Soviet Union officials. Also, in the nineteenth century, runaway slaves were thought to be suffering from drapetomania. Nowadays, we hold different values and, as such, do not aim to treat drapetomania anymore, nor political dissidence. According to Marc Ereshefsky, we believe that they are not a disease now and that they were not a disease in the past either. However,

[126] John Harris, "Is there a coherent social conception of disability?", *Journal of Medical Ethics* 26 (2000): 95.
[127] Jonathan Glover, *Choosing Children: Genes, Disability, and Design* (Oxford: Clarendon Press, 2006): 8-9.
[128] Tom Shakespeare and Nicholas Watson, "The Social Model of Disability: An Outdated Ideology?", *Research in Social Science and Disability*, vol. 2 (2002): 26.

if you are a proponent of the social model, you cannot afford this type of reasoning and 'you cannot say that those American doctors were wrong to call drapetomania a disease. All you can say is that we have different values than those nineteenth century doctors.'[129]

The objections presented in this section do not recommend the social model as a good explanatory tool in the separation of the normal from the abnormal in biology and the life sciences. Moreover, it also fails as a public policy guide due to its internal incoherence.

If the three most prominent and used accounts of normality fail to provide a sound theoretical underpinning and lack the capacity for effective guiding in public decision-making, then what are the alternatives that we are left with in delineating the limits of two of the core concepts – the normal and the abnormal – that lie at the heart of medical practice and of medical resource allocation? In the following lines, I propose a fourth model, the pure state account, which has evolved within physics and has been beautifully, though incompletely, linked to biology and medicine by Robert Wachbroit.

(4) The pure state account

In physics, the pure state and the ideal type represent the rough equivalent of the concept of biological normality. It is an imperfect correspondence in the sense that the pure state is an abstraction, a 'simplified representation of actual phenomena based on theoretical models',[130] while a normally functioning organ, for instance, does exist as a real component of a human body. Setting this difference aside, both the pure state and biological normality aim at fulfilling the same task: explanation through approximation. We have already seen that there are several methods of approximating normality in biology while relying on different benchmarks (statistics, bodily

[129] Marc Ereshefsky, "Defining 'health' and 'disease", *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 40 (2009): 224.
[130] R.Wachbroit, op. cit., p. 588.

functions or social input). In physics, however, there is only one relevant point of reference, which takes the form of an idealized version of the object or phenomenon that is under scrutiny. By being abstract, an ideal type has the advantage of being highly immune to variation and, thus, it may represent a strong and reliable indicator against which other things may be measured and assessed.

How could the pure state account be transposed and used in the life sciences, given the fact that biological normality exists not only in theory, but also in practice? Fortunately, there is a positive answer to this question. Despite the gap separating the two models, both of them can employ the same methodology for measuring the deviation from a fixed standard. In the case of biology, the fixed standard would not be an ideal state, but rather the physiological description of a biological system.[131] This description would most probably, though not necessarily, correspond to the type of explanations contained within medical textbooks, which are usually meant to capture the immutable core of their objects. Depending on the environment, this core may or may not correspond to a statistical average of the traits exhibited within the population. It is important to emphasize that textbook-like descriptions of biological systems do not represent pure types, but rather archetypes that embody fundamental characteristics and patterns. After the point of reference is established, namely the universal physiological description, normality and abnormality are assessed by comparing specific cases to these general standards. In other words, the evaluation of an actual human organ will follow after the initial unperturbed state of the archetype is being conditioned through more informational input in such a way as to match the parameters of the actual organ.

One of the main advantages of the pure state account is its consistency in delineating the normal from the abnormal. As such, a deviation from the point of reference would be regarded as a health impairment irrespective of the age at which it occurs, of the number of individuals that

[131] R. Wachbroit, op. cit., p. 589.

exhibit it or of the social input.[132] Also, unlike the etiological model, which focuses only on the evolutionarily assigned function of a body part, the ideal type takes into account other characteristics as well, such as physical descriptors (size, proportions etc) or chemical composition. Thus, a condition like dextrocardia, in which the heart is placed on the right side of the thorax rather than on the left, would be considered normal by the etiological model because the organ is still fulfilling its evolutionary function of pumping blood in the body. The pure state account, however, would classify it as abnormal because a dextrocardic heart does not comply with the physical description of an archetypal heart, which is located on the left side of the body. As dextrocardia is many times accompanied by cardiovascular and/or pulmonary complications, the pure state account seems to provide, at least in this specific case, a clearer overview of what biological normality is. This aspect constitutes a trustworthy indicator with respect to the model's reliability in shaping public policy. Given its superiority over other competing accounts, the pure state's view on normality and abnormality represents the starting point of my arguments related to the treatment – prevention – enhancement tristinction.

I would like to conclude this section by stressing one important aspect that I have kept in the background of this entire discussion surrounding biological normality, but which I have never fully expressed until now. The human body and its health lies at the intersection between genotypes and environments, between nature and nurture. Thus, whenever a genotype is classified as normal, this basically means that a specific set of genes has managed to find a proper environmental niche that can contribute to its flourishing. In this context, the environment should not be read as encompassing solely the social fabric of our communities. It also extends to all the other aspects that can act as epigenetic triggers, by being able to turn genes on or off. Among some of the most

[132]I exclude the input of medical practitioners from the social input on the ground that they are obliged by a code of ethics that prohibits the expression of social sentiments (like invidious discrimination, for instance) in the exercise of their profession.

known examples, I can mention one's lifestyle, parents' and grandparents' lifestyles, intrauterine nutrition and stress, microbiome, chemical exposure and even neighboring genes. Keeping this in mind, it follows that the abnormality of a phenotype may be equally caused by its associated genotype or environment. However, this does not mean that one cannot recognize a biological abnormality when one encounters one, which is what the pure state account's mission is.

3. Human enhancement and its classification

After having established the main defining elements of human enhancement and its position relative to treatment and prevention, this section is dedicated to the exploration of its conceptual richness, which is evident in its branching into so many distinct subtypes. More specifically, enhancements can be classified across five major lines: (1) the means used for enhancing; (2) the originality of the enhanced traits and the extent to which they are to be upgraded; (3) the type of human capacity that constitutes the object of enhancement; (4) the recognition of enhancement as enhancement or not; (5) the time when the enhancement is performed. I will address each of these points separately in the remainder of this section.

(1) Genetic and non-genetic enhancement

According to the means used for enhancing, human enhancement can be divided into two main categories: genetic and non-genetic.

I define genetic enhancement as the usage of a drug or the performance of a procedure intended to either modify the genotype of a person in such a way as to lead to the upgrade of her phenotype, or to select a genotype that is known to be associated with an improved phenotype. The reason for which both the genotype selection and modification are considered genetic enhancements is due to the fact that they are equally focused on acting upon genes, which become in this way the

target, as well as the vehicle, of enhancement. In spite of this similarity, genetic selection and genetic modification have quite different histories behind them. Selective breeding has constituted one of agriculture's favorite practices for hundreds of years already. Applied to humans, however, it first appeared in a negative light, as linked to eugenic policies and aims. More recently, though, it has gained moral and popular support while making its entrance into the field of reproductive medicine through the possibility of selective abortion and of pre-implantation embryo selection. On the other hand, targeted genetic modifications are still in their infancy and, although the research surrounding them is constantly expanding, to date there are very few cases in which they are intended for human use. In these rare exceptions, they are not aimed at enhancing, but rather at curing debilitating diseases, like, for instance, severe forms of pancreatitis.

Genetic selection and genetic modification can achieve different things. This difference can best be analyzed, again, in the field of agriculture. Goats, for instance, have undergone selective mating for many years in order to breed more effectively, which basically amounts to giving birth to genetically improved livestock. However, in 2010, scientists at the University of Wyoming genetically engineered goats to carry spider silk genes, and, in this way, to produce silk protein in their milk. These spider silk goats could turn out to be extremely useful for many industries, ranging from the pharmaceutical to the military one.[133] In the case of this kind of genetic modification, no process of selection could reach a comparable result, as the intervention brings about characteristics that no goat possesses prior to it.

Let us now turn to the second category of this classification, namely, non-genetic enhancement. Non-genetic enhancement could be briefly defined as the improvement of a human capability or function by acting upon phenotypes and environments. One interesting characteristic of non-genetic enhancement is that it can fall into very diverse typologies. Diet, training, peer

[133]Lisa Zyga, "Scientists breed goats that produce spider silk", *Phys.Org* (2010), available at http://phys.org/news194539934.html Last accessed: November 2013.

selection, non-genetic medical procedures and drugs, all represent some of its possible instantiations. Coffee, for example, is known to stimulate mental awareness. Reading or solving mathematical puzzles constitutes a type of training that has been shown to boost the cognitive capacities of those that engage in them on a regular basis. Ritalin, Modafinil and racetams can enhance various cognitive aspects in healthy individuals. Finally, plastic surgery is probably the most notorious example of an enhancing medical procedure that is performed without aiming at modifying the patient's genetic endowment.

Out of these two broad categories of human enhancements, the genetic one has always constituted a major point of debate and concern. What is special about human genetic enhancement - as opposed to the non-genetic means of improvement - that has managed to spark so much controversy? Ultimately, we admire and encourage positive modifications in one's environment, we look up to the parents that read stories to their children and thus stimulate their creativity, the intellectuals that spend days on end in the library or the athletes that undergo heavy endurance training in order to beat their own and others' records. Then why should genetic enhancements be of a different sort?[134]

There are four major concerns associated with the intentional modification of one's genotype. First, there is the issue of identity and authenticity; can we say that a person that has altered her genetic make-up remains the same after the procedure has been finalized? Second, due to the lack of effort and personal input into the improvement of the targeted traits, questions related to fairness, desert and excellence also come into play. Third, one could build a case against genetic

[134]James Hughes also captures this paradox very accurately and presents it beautifully in the following excerpt: "We frown at the mother who drinks and smokes heavily during pregnancy, and we smile on those who take their vitamins and then work hard to stimulate their newborns physically and mentally. Why is genetic therapy morally different? [...] We don't condemn parents who work to give their kids better diets or educational environments above the national average, we praise them." in Alex Mauron, Rabbi Barry Freundel, Erik Parens, Burke K. Zimmerman, Paul R. Billings, James Hughes, George Ennenga, Jan C. Heller, "Long-Term Possibilities and Dangers" in Gregory Stock and John Campbell (eds.), *Engineering the Human Germline: An Exploration of the Ethics and Science of Altering the Genes we Pass to our Children* (Oxford University Press, 2000): 132.

enhancement by arguing that it might lead to distorted familial relations, as it is likely to augment the pressure that some parents tend to put on their offspring. Finally, genetic enhancement may, though this is not always the case, go beyond the limits of what it means to be human and, in this way, it may violate and destroy human nature itself. Each of these four points needs to be properly presented and discussed, as they bring forth illuminating aspects with respect to the moral permissibility of human genetic enhancement. However, I will refrain from thoroughly addressing these concerns here because they may overlap with other categories analyzed in this section. As such, these four issues, together with a couple of other problems, will constitute the core of the next chapter.

(2) Enhancement of traits within the normal human distribution, enhancement of traits beyond the normal human distribution and enhancement of traits that no human naturally possesses

According to the extent to which traits are to be improved, enhancement can be classified into three categories: enhancement of characteristics within the normal human distribution, enhancement of characteristics beyond the normal human distribution and enhancement of characteristics that are not naturally present in human beings. In *Genes, Justice, and Obligations to Future People*, Frances Kamm rightfully credits the authors of *From Chance to Choice* for having emphasized this significant aspect.[135]

> No one knows the limits of our future powers to shape human lives – or when these limits will be reached. Some expect that at most we will be able to reduce the incidence of serious genetic diseases and perhaps ensure that more people are at the higher end of the distribution of normal traits. More people may have long and healthy lives, and perhaps some will have better memory and other intellectual powers. Others foresee not only greater numbers of people functioning at high levels, but the attainment of level previously unheard of: lives measured in centuries, people of superhuman intelligence, people endowed with new traits presently undreamt of.[136]

[135] Frances Kamm, "Genes, Justice, and Obligations to Future People" in Ellen Frankel Paul, Fred D. Miller Jnr, Jeffrey Paul (eds.), *Bioethics* (New York: Cambridge University Press, 2002): 361.
[136] A. Buchanan, D. Brock, N. Daniels and D. Wikler, op. cit., p. 1.

In order to illustrate the differences between the first two categories – enhancement of traits within the normal human distribution and improvement beyond the normal human distribution - I will resort to my favorite example, namely, that of cognition. Imagine that, at an indefinite time in the future, you are able to step into your physician's office and ask him to upgrade your IQ from 140 to 160. 160 is a rare IQ score, even for indefinite future times. However, it is not impossible to find a few people that have been naturally blessed with this gift. Upon making your request, the doctor informs you that his cabinet has recently introduced a new health service: IQ enhancement beyond 160. You are free to choose any value you want, as long as it does not exceed 300. Because you enjoy reading moral philosophy in your spare time, you do not know what the right thing to do is. On the one hand, an IQ of 200 or 300 would constitute a huge improvement in your life and it might lead the way to unimaginable mental experiences. On the other hand, no human being has ever possessed such great intelligence. Thus, wouldn't any enhancement that went beyond 160 represent a threat to your human core itself? After allowing your doctor to raise your IQ to 170, for instance, would you still be a human being? There is only a difference of 10 units between 160 and 170. But could it be that these 10 units are of such great moral relevance as to demarcate what is human from what it is not? You cannot make up your mind on the spot, so you excuse yourself and promise to return after having given this issue more thought. Which is what I am going to do as well and guarantee to return to these problems in the following chapter.

Now, the third category of this classification, namely, the enhancement of traits that no human naturally possesses, is even more problematic than the second. What it amounts to is basically the ability to create a new human characteristic that no one has ever been endowed with in the absence of genetic engineering. For instance, one could imagine a new sense added to the five ones that we have naturally inherited from our predecessors. Suppose this is telepathic communication. The addition of one such trait does not only go beyond the normal distribution of

our features, but it also redraws the contours of the human being itself. This might intensify the previously mentioned issues related to personal identity and species integration.

All the three types of enhancement contained within this classification can be achieved through genetic means. However, only the first category, that of improvement within the normal distribution of human characteristics, could be performed without relying on genetics. This means that the enhancement that goes beyond the normal distribution of traits and that which targets the addition of a new human feature are necessarily types of genetic enhancement. We have seen so far how morally challenging these two procedures could be. We have also discussed, in reference to the previous classification, how genetic enhancement is more problematic from an ethical standpoint as compared to non-genetic upgrade. What is interesting to notice now is the way in which the more sensitive categories of these two rankings end up overlapping and representing an intertwined target for the critics of unnatural human enhancement.

(3) Physical, cognitive and moral enhancement

According to the type of human capacity that constitutes its object, enhancement can be physical, cognitive or moral. Physical enhancement is meant to upgrade the function or appearance of different body parts. For instance, one might physically enhance oneself by increasing the air intake of one's lungs or by surgically redrawing the contours of one's cheekbones. On the other hand, the goal of cognitive enhancement is to improve the intellect and to speed up different cognitive processes. Some specific aims of this type of enhancement would be boosting individuals' memories, analytical skills or logical rigor. Lastly, moral enhancement represents an upgrade in the moral sentiments and behavior that individuals normally exhibit.

Although distinct in theory, these three types of enhancements may easily overlap in practice. To be more specific, there can be numerous cases in which only one intervention

conducted on a single body part may simultaneously bring physical, cognitive and moral benefits. To clarify this point, I will use an example. Suppose, for instance, that by releasing nanorobots in the bloodstream it would be possible to perfectly control insulin production in such a way as to avoid even the smallest insulin spikes. Although one would feel tempted to characterize this enhancement as a physical one, due to the fact that its direct object is the pancreas, in fact, the effects of the nanorobots' activity would also reach the cognitive and moral fields. How? First, as there are no insulin spikes anymore, the drowsiness that is usually associated with them disappears as well. As such, mental alertness is prolonged, which means that different cognitive processes may be put to use, in their peak state, throughout a longer period of time. Cognition represents one of those fields in which not only an upgrade in a desired good constitutes a benefit, but also the prolongation of its delivery time. This extended time frame would enable individuals to take advantage of the momentum that is constantly built through uninterrupted focus in order to provide faster and potentially better solutions to their problems. Now, cognitive enhancement may, in some cases, lead to moral enhancement, as the newly acquired improvement in reasoning may also cause beneficial changes in moral decision-making. Consequently, one single intervention can fulfill seemingly unrelated tasks.

Curiously enough, each of the three types of enhancements presented above have given birth to both criticism and praise. As such, physical and cognitive improvements have raised the issue of social coordination by bringing to the forefront the problem of positional goods. What happens if enhancements would not be pursued for their intrinsic value, but rather as means for securing a social advantage? This would be a bleak scenario from which no one would ultimately gain. In this sense, Fred Hirsch was absolutely right in stating that '[i]f everyone stands on tiptoe, no one sees better.'[137] Physical and cognitive enhancements can also constitute a target for Michael

[137] Fred Hirsch, *Social Limits to Growth* (Cambridge, Mass.: Harvard University Press, 1976).

Sandel's appeal to excellence.[138] As such, one could argue that any achievement backed by unnatural enhancement, as in, for instance, the case of doped athletes, loses its element of grandeur and admiration because there is no real effort involved in it. At most, the effort is that of the physician or of the researching scientist, but definitely not that of the enhanced individual.

Another line of criticism is targeting, this time, cognitive and moral enhancements as well. It is the issue of identity loss and lack of authenticity. In the words of Elliott,

> [w]hat is worrying about so-called "enhancement technologies" may not be the prospect of improvement but the more basic fact of altering oneself, of changing capacities and characteristics fundamental to one's identity . . . Making him smarter, giving him a different personality . . . mean, in some sense, transforming him into a new person.[139]

As I was previously mentioning, these three kinds of enhancements are not only prone to objections, but they also elicit support among bioethicists and moral philosophers. For instance, one might argue that in the absence of a cognitive upgrade, we might simply put a cap on all further scientific and technological development. According to this view, we are rapidly and surely approaching the upper bound of our innate capacities. One proponent of this account, Nick Bostrom, argues in his 'Letter from Utopia' that there are unimaginable intellectual pleasures that are left undiscovered simply because we do not have the necessary cognitive endowment to grasp them. As such, our potential future selves living in Utopia are doing their best to stir us toward enhancement so that their future existence may become, in this way, actualized. In the letter that they address to us, they write the following:

> Your brain must grow beyond any genius of humankind, in its special faculties as well as its general intelligence, so that you may better learn, remember, and understand, and so that you may apprehend your own beatitude. [140]

While Bostrom perceives cognitive enhancement as a duty that we owe to future people, Savulescu and Persson argue in 'Unfit for the Future' that we have an obligation toward the present

[138] Michael J. Sandel, "The Case Against Perfection", *The Atlantic* (Apr. 2004).
[139] C. Elliott, *A Philosophical Disease: Bioethics, Culture and Identity* (NY: Routledge, 1999).
[140] Nick Bostrom, "Letter from Utopia", *Studies in Ethics, Law and Technology*, Vol. 2, No.1 (2008): 1-7.

people to morally enhance ourselves, so that we can avoid two of humanity's biggest problems: the threat posed by the weapons of mass destruction and the danger of environmental degradation.[141]

In the end, what this classification shows is that when enhancement ceases to be an abstract formulation and is instead oriented toward particular individual or social goals, its moral status becomes even more controversial, while oscillating between two extremes: from an unjustifiable and unfair procedure, to a duty that we have toward current and future generations.

(4) Front-door and back-door enhancement

According to the kind of recognition that it receives, enhancement can be divided into two types: front-door and back-door enhancement.[142] One can include within the first category those drugs and procedures that are introduced on the market as enhancements. The second typology, however, contains the drugs and procedures that are recognized as treatments or preventative measures, but, at the same time, exhibit the yet untested potential for upgrading normally functioning traits or processes of otherwise healthy people. Unfortunately, the number of back-door enhancements probably exceeds the number of the front-door ones on the medical market. The most notorious examples of back-door enhancing drugs are those of ADHD and stroke recovery medication, like Ritalin, Modafinil and racetams. As these drugs are meant to boost the cognitive capacities of individuals suffering from different kinds of impairments, they are also used by a large number of people in the hope of upgrading their own cognition from good to better.

Unfortunately, whenever enhancement is introduced through the back door, it is a hazardous undertaking because it is not subjected to rigorous testing that could determine its short-term and long-term effects on healthy individuals. Nonetheless, the fact that the back-door type of

[141] Julian Savulescu and Ingmar Persson, *Unfit for the Future: The Need for Moral Enhancement* (Oxford: Oxford University Press, 2013).
[142] I got acquainted with this distinction while reading Allen Buchanan's *Better than Human*.

enhancement may pose some health risks does not have any bearing on the safety of the front-door prototype.

(5) Pre-birth and post-birth enhancement

According to the time of their performance, enhancements may fall within two main categories: pre-birth and post-birth. At their turn, post-birth enhancements may be divided into two further subtypes: pre-adulthood and post-adulthood interventions.

Two of these categories, namely, the pre-birth and pre-adulthood ones, are especially problematic when it comes to such issues as justice in upbringing, child-parents relationship, lack of consent and the endangering of the child's autonomy. As all of these concerns can be identified among the typical objections brought against enhancement, they will be addressed in more detail in the next chapter, which is dedicated precisely to this topic. However, before proceeding to it, I would like to emphasize that whatever makes enhancement contestable, from the perspective of the time when it is carried out, is solely related to the fact that the identity of the procedure's decision-maker does not coincide with that of its receiver.

CHAPTER 4

Human Enhancement and Its Critics

Read the directions and directly you
will be directed in the right direction.
(L. Carroll)

After having defined, classified and placed human enhancement on the axis of medical services, I will proceed now to outlining the main lines of criticism that can be brought against it. The aim of this chapter is to test the limits of the moral justifiability of enhancement and to see which of its objections can be dismissed or not. The critique presented here will be directed against all forms that human enhancement might embrace, although some of it will be targeting certain types more than others.

The arguments formulated by the critics of enhancing procedures are usually structured around the idea that upgrading human beings might or will even necessarily lead to harming the enhanced individual herself, the society that she belongs to and/or humanity taken as a whole. Let us now take a closer look at each main line of criticism raised against enhancement and check whether it can be satisfactorily answered or not.

1. The appeal to excellence

The objection against enhancement coming from excellence has been very well formulated by the US President's Council on Bioethics in one of its staff working papers:

> In activities developed to strain the limits of what a human being can do (like running a race), enhancements change the background against which excellence is admired. In a race in which all the participants have used performance-enhancing drugs, we may find it easier to admire the chemists

> than the athletes, and the meaning of the accomplishments involved will be greatly diminished. This is in essence an argument about integrity in the pursuit of excellence [.][143]

While sticking to the example of professional athletics, which can express very well the core of this argument, it is important to emphasize that even when we are speaking about individual athletes, we have to bear in mind the fact that their results are not theirs alone. As such, whether athletic performance has been medically enhanced or not, it would be unfair not to admire alongside the athlete her entire staff, which, depending on the case, may be comprised of a coach, athletic trainer, exercise physiologist, kinesiotherapist, primary care sports medicine practitioner, sports nutritionist, psychological counselor. The natural endowment of the athlete, her effort and dedication in pursuing her practice are only a part of the variables that can account for her results.

By dramatically modifying their weight, professional wrestlers can drop a lot of pounds just before a weigh in, while regaining them very quickly before the competition begins. The purpose of these feats is to offer wrestlers a higher chance of winning by placing them in a category that does not in fact correspond to their body type. It is basically an enhanced route toward success which, if done without proper medical supervision, could be extremely dangerous. Excessive dehydration and lack of adequate nutrients could pose the hardest problems. In the end, the wrestler's enhanced performance can be traced back both to the wrestler herself, who has to undergo the pain of starvation and water loss, and also to her staff, when capable of devising a successful plan that leaves the competitor with an advantage.

We also admire an athlete's staff and not just the athlete herself when the former build well-thought programs and routines, which corroborated with the latter's effort and perseverance lead to impressive results. A balanced diet, proper supplementation, comfortable clothing and footwear, adequate training and, in many cases, even exercise regimens that are expertly pushed to the limits of

[143] The President's Council on Bioethics, *Distinguishing Therapy and Enhancement* (Washington D.C., 2002): 1.

human endurance (like altitude training or oxygen tents) can make a big difference on whether a skilled and hard-working athlete will win her match or not. The athlete is ultimately one link in a chain and possibly its most important one. However, objecting to human enhancement on the grounds that it distorts our attitude toward excellence only shows that we do not really understand what excellence presupposes, in most fields, and how complex and intricate its web of relationships is. Similarly, we can safely argue that capacities are not sufficient for achieving excellence. They also need to be skillfully applied. As such, the possibility of enhancing capacities does not cover this latter aspect either.

2. The relation of means to ends

This objection against human enhancement can embrace two forms. On the one hand, medical enhancement is thought to be disruptive of a normal means to ends relationship by removing the element of intentionality, which is conducive, in the long run, to a deeper understanding of the world, personal growth and flourishing.

> [b]iomedical interventions act directly on the human body and mind to bring about their effects on a subject who is not merely passive but who plays no role at all. In addition, he can at best *feel* their effects *without understanding their meaning in human terms*. Thus, a drug that brightened our mood would alter us without our understanding how and why it did so – whereas a mood brightened as a fitting response to the arrival of a loved one or an achievement in one's work is perfectly, because humanly, intelligible. And not only would this be true about our states of mind. All of our encounters with the world, both natural and interpersonal, would be mediated, filtered, and altered. Human experience under biological intervention becomes increasingly mediated by unintelligible forces and vehicles, separated from the human significance of the activities so altered (the intelligibility of a scientific account of the mechanism of action of the biological agent would not be the intelligibility of human experience). The relations between the knowing subject and his activities, and between his activities and their fulfillments and pleasures, are disrupted.[144]

In order to reply to this objection, I will use the very example that the President's Council on Bioethics depicts in the above paragraph: mood. In the past few years, the field of positive

[144] The President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Human Improvement* (Washington D.C., 2003).

psychology, also informally referred to as the science of happiness, has really expanded and started delving deeper and deeper into the understanding of the founding blocks of happiness and into mapping a route to help as many people as possible to get there. According to a massive body of research in this field, happiness or one's positively tilted mood can be explained by the incidence of three constitutive elements: genetics, intentional behavior and external circumstances. Now, interestingly enough, these three factors do not coexist in equal proportions, but they are rather unevenly distributed. Genetics, for instance, accounts up to 50% of your happiness or lack thereof, while external circumstances make up a mere 10%, the remaining 40% being reserved to intentional behavior.[145] So, this shows that trying to explain and understand one's mood is a much more complicated endeavor than we might normally expect. If we really want to pinpoint all the variables that lead to a state of happiness or unhappiness, we would probably have to start from our family tree and a genome analysis and then continue with a psychology session aimed at unraveling the roots of our behavior. Thus, while the President's Council on Bioethics suggests that the arrival of a loved one would lead to 'a mood brightened as a fitting response'[146] and, in this way, it could explain why we feel how we feel, they neglect the fact that the arrival of a loved one is an external circumstance, which accounts only for 10% of our happiness. Basically, my response to this objection against human enhancement is that it is presumptuous to state that we can really grasp the complexity of our world in an unfiltered, unmediated way. Furthermore, human enhancement need not obstruct this understanding, but it might even enrich it. Just imagine all the possibilities opened up by cognitive enhancement or even the wide range of emotions offered by moral enhancement, which could help shed more light on many aspects of what it means to be a human being. Finally, maybe it is worth looking at the end value itself, at what is attained by and through human

[145] Sonja Lyubomirsky, *The How of Happiness: A Scientific Approach to Getting the Life you Want* (Penguin Books, 2008).
[146] The President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Human Improvement* (Washington D.C., 2003).

enhancement, separately from any other procedural considerations. As Nick Bostrom and Rebecca Roache suggest, 'the end state may have value independently of the means by which it is achieved, meaning that bringing about the end state using less valuable means is better than not bringing it about at all.'[147]

The second form of the 'means to ends relationship' objection has nothing to do with the way in which we, humans, relate to our environment, but is focused instead on the issue of effort. As it goes, this version of the objection states that effort is intrinsically valuable, it gives meaning to any personal achievement and it ultimately shapes human identities. Andy Miah offers a very good example that is illustrative of the significance of effort for our evaluation of human endeavors and accomplishments. Imagine you want to reach the peak of a mountain. Would it be the same thing reaching it after hours or even days spent climbing, as compared to taking a helicopter?[148]

Effort is deeply embedded in the way in which we, taken individually or in groups, decide on the value of different actions and behaviors. According to Brey, effort is basically a cultural heuristic for assigning merit, and dismissing it as such might jeopardize many of our social constructions, distributive patterns and justice principles:

> Human enhancement could […] seriously alter the conventional relation between effort, self-improvement and achievement, as is already happening in sports due to the use of doping. Yet, the relation between effort and achievement is very important in many religions and ideologies, from Buddhism to Christianity and from socialism to liberalism. These ideologies all emphasize the central role of effort and training in achievement and self-actualization, and define human identity in terms of it.[149]

Now, surprisingly enough, this objection against human enhancement is being answered by none other than one of the starkest opponents of medical enhancement, Michael Sandel. In his

[147] Nick Bostrom and Rebecca Roache, "Ethical Issues in Human Enhancement" in Jesper Ryberg, Thomas Petersen and Clark Wolf (eds.), *New Waves in Applied Ethics* (Pelgrave Macmillan, 2008): 133.
[148] Andy Miah, "Ethical Issues Raised by Human Enhancement" in F. Gonzalez (ed.), *Values and Ethics for the 21st Century* (BBVA, Spain): 199-231.
[149] P. Brey, "Human Enhancement and Personal Identity" in J. Berg Olsen, E. Selinger, S. Riis (eds.), *New Waves in Philosophy of Technology. New Waves in Philosophy Series* (New York: Palgrave MacMillan, 2009): 182-183.

famous *The Case Against Selection,* Sandel argues that the relationship between effort and merit or between effort and excellence is not to be endangered by enhancing technologies. In his own words,

> excellence consists at least partly in the display of natural talents and gifts that are no doing of the athlete who possesses them. This is an uncomfortable fact for democratic societies. We want to believe that success, in sports and in life, is something we earn, not something we inherit. Natural gifts, and the admiration they inspire, embarrass the meritocratic faith; they cast doubt on the conviction that praise and rewards flow from effort alone. In the face of this embarrassment we inflate the moral significance of striving, and depreciate giftedness. […] But effort isn't everything. No one believes that a mediocre basketball player who works and trains even harder than Michael Jordan deserves greater acclaim or a bigger contract.[150]

Thus, according to Sandel, any human achievement or feat of excellence can be obtained through an uneven mix of effort and talent. Some rely more on the latter, while others on the former. What is essential for our discussion of human enhancement, nonetheless, is the fact that societies do not discriminate between the means used to achieve excellence. If the end results are similar, then they will receive equal compensations. In this context in which we do not reward more a less talented but a harder-working athlete as opposed to one who is more gifted and less willing to invest a lot of effort in her practice, why would we treat differently yet another means for human performance, which is that of medical enhancement?

Apart from the answer outlined by Michael Sandel, there is also a second way in which one could reply to this objection centered on the issue of effort. The core of the objection relies on the distinction between the given and the un-given or, differently put, between the immutable, which is insulated from human control, and the mutable, the realm placed under the spectrum of human agency and initiative. In this equation, talent stands for the given and it is considered to be outside of human will and, more importantly, influence. On the other hand, effort represents the un-given and it is the direct product of human action and determination. This strand of the 'means to ends

[150] Michael Sandel, "The Case Against Perfection", *The Atlantic Monthly* 293(3) (2004).

relationship' objection to medical enhancement can be most powerful when read from the perspective of desert.

According to some desert theories of justice[151], a necessary condition for someone to be entitled to receive a certain good is to be responsible for it. Thus, responsibility constitutes the basis of desert. Now, the natural question to follow is this: what would, in turn, constitute the basis for assigning responsibility? Looking at the distinction from the previous paragraph between talent and effort, an intuitive response would be to rely on effort as the basis for responsibility. Also, in much of the literature on desert of wages, for instance, it is being argued that wages are deserved either for productivity or effort. As people cannot be fully responsible for their productivity, it is effort, in the end, the element which should determine the deserved wage.[152]

The problem with this argument is that even our capacity for effort and, ultimately, the amount of effort that we are willing to invest in a certain enterprise is not something that we can perfectly control. Each of us is born with a certain genetic material and raised in a specific environment, which will jointly determine many personality traits that will influence our attitude toward effort. John Rawls also captures the core of this idea, but from an angle which is tilted a bit more toward nurture as opposed to nature:

> We do not deserve our place in the distribution of native endowments, any more than we deserve our initial starting place in society. That we deserve the superior character that enables us to make the effort to cultivate our abilities is also problematic; for such character depends in good part upon fortunate family circumstances in early life for which we can claim no credit. The notion of desert plays no role here.[153]

[151] Please see Geoffrey Cupit, "Desert and Responsibility", *Canadian Journal of Philosophy* 26 (1996): 83-100; and Fred Feldman, "Desert: Reconsideration of Some Received Wisdom", *Mind* 104 (1995): 63-77; and Fred Feldman, "Responsibility as a Condition for Desert", *Mind* 105 (1996): 165-168.
[152] Owen McLeod, "Desert", *The Stanford Encyclopedia of Philosophy* (Winter 2013 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/win2013/entries/desert/>.
[153] John Rawls, *A Theory of Justice* (Oxford: Oxford University Press, 1971): 89.

Letting aside the fact that the amount of effort that we can invest in our activities is not entirely under our control, it is also important to emphasize that enhancements do not completely eliminate the significance of effort. They simply raise the baseline compared to which effort may be exerted.

Now, it appears that one can adequately reply to the 'means to end relationship' objection brought against human medical enhancement and, as such, the objection, in both of its interpretations, cannot represent a valid criticism against enhancing procedures.

3. The distortion of human normality

This objection against human medical enhancement starts from the assumption that enhancement will be sought for upgrading one's capacities in a way that is consonant with the values embedded in one's social environment. As such, most enhancing procedures will follow a similar path, aiming to achieve a human trait that is admired and rewarded at the collective level. This scenario is deemed to be problematic due to the fact that the uniformity of the nature of the pursued enhancements will eventually lead to changes in the characteristics possessed by quite a large number of human beings. As a consequence, what would have been called normal in the pre-enhancement era might not deserve the same status in the post-enhancement one. According to some conservative positions, this probable distortion of human normality could be regarded as a moral drawback of enhancement.

In order to reply to this objection, I will not argue against the fact that medical enhancements might redraw the boundaries of human normality. I do intend to show, nonetheless, that redefining the limits of different human capacities and achievements is not a strong reason for moral concern. In this sense, we have been constantly witnessing an ascending trajectory of human feats, endowments and features throughout our entire history. Rather than meeting these social,

economic and scientific accomplishments with skepticism and moral pessimism, we have embraced them with pride and with a sense of achievement. Thus, not only that we tolerated the abnormal that goes beyond the upper limits of the normal, but we still continue to do so in many areas and, furthermore, those that are actively seeking it are mostly encouraged and looked upon. Basically, what I want to highlight is that the potential of medical enhancement to distort our idea(s) of normality is similar to other disruptive phenomena that we have lived in our more distant or more recent past. In spite of this, however, medical enhancement is perceived differently: as a threat and not as an accomplishment. This reasoning might stem from the unparalleled novelty of the promises of enhancing technologies and also from the fact that enhancements aim at making the transition from good to better and not from bad to good. In the end, we might as well have a reasonably good life in the absence of medical enhancements. Why would anyone jeopardize it for a trial and error path toward the best life, which might not even be enjoyed during one's lifespan, but primarily by unknown and possibly unrelated future generations? Given all of this, the reasoning pattern applied to enhancements might represent a fertile ground for the development of *status quo* biases. Nick Bostrom and Toby Ord also put forward this latter idea, claiming that 'one prevalent cognitive bias, status quo bias, may be responsible for much of the opposition to human enhancement.'[154] One can easily identify *status quo* biases by employing a heuristic that Bostrom and Ord have called 'the reversal test':

> *Reversal Test*: When a proposal to change a certain parameter is thought to have bad overall consequences, consider a change to the same parameter in the opposite direction. If this is also thought to have bad overall consequences, then the onus is on those who reach these conclusions to explain why our position cannot be improved through changes to this parameter. If they are unable to do so, then we have reason to suspect that they suffer from status quo bias.[155]

[154] Nick Bostrom and Toby Ord, "The Reversal Test: Eliminating Status Quo Bias in Applied Ethics", *Ethics* 116 (2006): 657-658.
[155] N. Bostrom and T. Ord, op. cit., pp. 664-665.

In order to perform the reversal test in the case of medical enhancement, we would have to reverse our perspective and ask a rather counterintuitive question: If upgrading the human body from good to better is undesirable, would using some risk-free method to transition from good to bad have net good consequences? It is safe to argue that the vast majority of those opposing medical enhancement would answer no to the previous question. Their answer, however, would put them in the position of defending the optimality of current human characteristics and capacities, which would turn out to be a fairly difficult task, given that we live in a world that is far from being optimal.

I believe it is safe to argue that objecting to human enhancement on the grounds exposed in this section is an instance of *status quo* bias. However, this line of criticism might gain more credibility if coupled with the idea that medical enhancement has not only the potential of transcending the limits of human normality, but of human nature itself.

4. The violation and destruction of human nature

This objection follows naturally from the previous one. Thus, through repetitive rounds of enhancements that take the limits of human normality further and further away and through the upgrade to traits that no human being has ever possessed before, medical enhancing technologies present the danger of violating and destroying our nature and the very core of our humanity.

In order to properly understand this objection, the first step that needs to be taken is to have a closer look at the issue of human nature itself and into those characteristics that lay at its foundation. Thus, what distinguishes individuals like you and me from other known species and what makes us, humans, human? This question has been asked since antic times, it continued to be addressed during modernity and it is still a favorite topic for debate among contemporary philosophical circles. Although many have expressed skepticism at the attempt of trying to pinpoint

the essential traits of human nature, others have chosen to accept the challenge. Among the various accounts of human nature that have already been brought into the limelight, there seems to emerge one favorite essential human characteristic: the human intellect and its capacity for reason. Of course, it would be presumptuous to argue that reason alone is the essence of humanity. Nonetheless, irrespective of whatever else might exist (or not) along its side, it is most certainly a good and promising starting point for a discussion of this type.

Objecting to medical enhancement on the grounds that it may lead to the violation and destruction of human nature may follow two routes. On the one hand, one might argue that human nature is intrinsically valuable and, as such, its annihilation is wrong in itself. On the other, it could be claimed that human nature is instrumentally necessary for the existence of many other types of goods, such as human dignity or close interpersonal relationships. I will proceed now with a deeper analysis of each of these arguments, the first one being dedicated to the intrinsic value of human nature and its constraints on medical enhancement.

According to G. A. Cohen, 'the reason to preserve human beings (as they are) [is] that they are creatures that exhibit a certain form of value.'[156] Value is not the only thing worthy of being valued, but also its bearer. Cohen labels this as the act of 'valuing the valuable', in which not only intrinsic value should be valued, but also 'the particular object that instantiates the value *qua* particular.'[157] Thus, anytime there is an attempt to replace a value bearer with one that is of a higher quality, we in fact devalue the former and fail to recognize it as what it is. Applied to medical enhancement, Cohen's position occupies a middle place, as it is permissive with some types of enhancements and impermissive with others. More specifically, under Cohen's conservative framework, those enhancements that aim at preserving existing values and their bearers are morally

[156] Gerald Allan Cohen, "Rescuing Conservatism" in R. Jay Wallace, Rahul Kumar and Samuel Freeman (eds.), *Reasons and Recognition: Essays on the Philosophy of T.M. Scanlon* (Oxford: Oxford University Press, 2011): 209.
[157] G. A. Cohen, op. cit., p. 207.

justifiable, whereas those that go beyond this limit are not. In other words, enhancements that improve different human capacities without annihilating and replacing human nature - which is a value in itself - with something of a potentially higher quality are morally justifiable. The rest do not enjoy the same moral status.

It is very hard to object to Cohen's argument, given that human nature and humans, as its bearers, will always be considered objects worthy of being valued, irrespective of the balance between the good and the evil that rests within them. Thus, as long as there are some qualities that can cast value on the human nature and, implicitly, on humans, it would not really matter, for Cohen's account, if these qualities were outnumbered by other shortcomings. At least at a first glance, this position seems to be resting on shaky moral grounds. Intuitively, one would not claim that one good deed could compensate for a very bad one, let alone ten or even a hundred. Similarly, a person that aims at developing a virtue cannot erase her sin(s). Even in the case of human nature, which is ultimately a mixture of traits - some better than others -, it is extremely difficult to justify the moral value of the whole by focusing on a few components. In spite of this, Cohen believes that this latter enterprise is doable and can even be successful if one does not disregard the fact that human nature is a complex whole, an indivisible construction that rests on its interdependent links.

> If I want us to continue as we are, do I want us to retain our negative features? What if a genetic manipulation could, for example, eliminate envy?… I would not want to eliminate all of our bad features. I conjecture that that is partly because the negative traits are part of the package that makes human beings the particular valuable creatures that we personally cherish, and are therefore worth preserving as part of that package…[158]

Now, if negative traits are worth preserving, why do we, as humans, discourage their manifestation through all sorts of means and praise their reprisal? Since the dawn of civilization, wrongdoers have been punished in countless ways, ranging from incarceration to physical rebuke.

[158] G. A. Cohen, op. cit., p. 209.

Moreover, these punishments have not been intended and conceived for the wrongdoers alone, but they have been constantly targeting the whole society at large. Thus, judicial sentences need to be perceived as educational tools as well, given that one of their fundamental aims is to promote a behavior that is consonant with morality's requirements (at large) and to deter people from morally wrong actions and dispositions. We do not only attempt to annihilate or, at the very least, minimize as much as possible the negative features within human nature through the way in which our legal systems have been set out and evolved throughout time. We also try to achieve the same type of results by instilling certain moral precepts and behavior guidelines to children during their upbringing or by accepting and sanctioning the teachings of various religions and religious-like institutions. In this context, in which humanity has been constantly seeking to emphasize and cultivate the best aspects of its nature, while consciously and deliberately rejecting the less positive ones, it would be a *non-sequitur* to object to medical enhancement for trying to do the same thing. Like many other criticisms that have been formulated against enhancing technologies, Cohen's objection to medical enhancement is ultimately an instance of the dissonance in moral attitude that guides medical and non-medical enhancement while they are in the pursuit of the same goals.

Letting all these considerations aside, Cohen's argument can also lead to morally problematic conclusions when stretched to its limits. Let me be more specific. Children of any age can be perceived as bearers of value, given that they possess the fundamental characteristics that make up human nature. As they become older, many of the traits that had just started to develop within them fully blossom and they change, as bearers of value, from children to adults. It would be no exaggeration to argue that, in terms of their characteristics, a child and the adult that she grows into are different. Using Cohen's terminology, they could very well represent two different types of value bearers, out of which one, the adult, is neatly superior in terms of trait development. Now, as Cohen claims that one should preserve value and value bearers even when they could be replaced by

something or someone of a greater value, it is interesting to notice that radical medical interventions might actually come in handy for this very purpose, which is that of preventing children from becoming adults. The pillow angel case[159], in which a mentally disabled girl was intentionally shortened and sterilized in order to stop her growing process, is testimony to that. The question that follows, nonetheless, is whether this course of events would be the right thing to do. Relying on intuition alone, the answer would be no. Also, if we dealt with this issue on more practical grounds, the answer would still be no due to the fact that one cannot even imagine how the human species would survive as long as children, as value bearers, would stop being replaced by adults. Given all these considerations, I argue that Cohen's objection against medical enhancement does not constitute valid criticism.

I will proceed now to outlining those objections formulated against medical enhancement as a possible destructor of human nature, in which the latter is being perceived as a necessary means for the existence of other goods. One such good that might be jeopardized in the eventuality in which human nature is altered is human dignity. This point of view has been famously defended by Francis Fukuyama in *Our Posthuman Nature.* According to Fukuyama, human nature can be defined as 'the sum of the behavior and characteristics that are typical of the human species, arising from genetic rather than environmental factors.'[160] As Dan Brock accurately noticed, Fukuyama's take on human nature is an empty concept because all human characteristics are the product of both genes and environment.[161] Fukuyama's definition of human nature is problematic on other grounds as well. We know, for instance, how human chromosomes are supposed to look like in the average person. What happens then, under this framework, with those individuals who exhibit chromosomal

[159]Nancy Gibbs, "Pillow Angel Ethics", *Time* (Jan 7, 2007), available at http://content.time.com/time/nation/article/0,8599,1574851,00.html Last accessed: June 2015.
[160] Francis Fukuyama, *Our Posthuman Nature: Consequences of the Biotechnology Revolution* (Farrar Straus & Giroux, 2002): 130.
[161] Dan Brock, "Messing with Mother Nature", *American Scientist* (September – October 2002), available at http://www.americanscientist.org/bookshelf/pub/messing-with-mother-nature Last accessed: June 2015.

abnormalities, like the Down's syndrome? Excluding them from within the reach of human nature seems to be an invidiously discriminatory attitude, unjustifiable on the basis of genetics alone. The Down's syndrome example can be followed by many other cases in which certain genes that need not be associated with a disadvantageous phenotypical trait are possessed solely by a minority of people. Thus, could one say that those individuals who exhibit rare genes positively correlated with an increased longevity or with better HIV resistance are not part of the human species? It would be difficult to answer to this question in the affirmative, when all evidence points to the contrary.

Fukuyama's account seems to imply that human nature is instrumentally valuable as a prerequisite for the existence of human dignity, which, at its turn, constitutes the basis for the granting of human rights. Curiously enough, human dignity is not founded on human nature as a whole, but only on its essence, which Fukuyama calls 'Factor X'. Factor X represents 'some essential human quality underneath that is worthy of a certain minimal level of respect'[162], but, unfortunately, it cannot be described in high detail. Nonetheless, it constitutes the central concept of Fukuyama's view of human dignity and it is discussed, at a deeper level, in the following paragraph:

> If what gives us dignity and a moral status higher than that of other living creatures is related to the fact that we are complex wholes rather than the sum of simple parts, then it is clear that there is no simple answer to the question, What is Factor X? That is, Factor X cannot be reduced to the possession of moral choice, or reason, or language, or sociability, or sentience, or emotions, or consciousness, or any other quality that has been put forth as a ground for human dignity. It is all of these qualities coming together in a human whole that make up Factor X. Every member of the human species possesses a genetic endowment that allows him or her to become a whole human being, an endowment that distinguishes a human in essence from other types of creatures.[163]

As it is part of human nature, Factor X is prone to the same conceptual problems that I have already highlighted in relation to Fukuyama's grounding of human nature on genetic factors alone. Let us now disregard these issues and suppose that they either do not exist or that they could be satisfactorily solved. Only if this were the case could we proceed to the matter that is really of

[162] F. Fukuyama, op. cit., p. 149.
[163] F. Fukuyama, op. cit., p. 171.

interest here: human enhancement. Fukuyama's position regarding biotechnological enhancement is very well summarized below.

> What is that we want to protect from any future advances in biotechnology? The answer is, we want to protect the full range of complex evolved natures against attempts at self-modification. We do not want to disrupt either the unity or the continuity of human nature, and thereby the human rights that are based on it.[164]

One important thing in need of clarification is the fact that there is no direct connection between human nature, in its complexity, and human dignity. Their linkage is being provided by Factor X. A legitimate concern that could arise, in this context, is that Factor X, as the very core of humanity, might still remain immutable even if human nature itself were to change through biomedical enhancements. If this were the case and, given the width of Factor X it might very well be, human enhancement should not pose any threat to the existence of human dignity. Thus, as Fukuyama's objection to enhancing biotechnologies does not rest on their potential for distorting human nature, but for that of destroying the foundation of human dignity, it could be argued that his criticism is misdirected and, ultimately, weak.

Another famous opponent to biomedical enhancement on the ground that it changes human nature as we know it is Jurgen Habermas. Similarly to Fukuyama, Habermas does not object to the disruption of human nature as a wrong in itself, but mainly because it brings along modifications of the utmost importance in the way in which we perceive other people and ourselves, as well as in the structuring of our relationships.

> The manipulation of the makeup of the human genome, which is progressively being decoded, and the hopes entertained by certain scientists of soon being able to take evolution in their own hands do, after all, uproot the categorical distinction between the subjective and the objective, the naturally grown and the made, as they extend to regions which, up to now, we could not dispose over. What is at stake is a dedifferentiation, through biotechnology, of deep-rooted categorical distinctions which we have as yet, in the description we give of ourselves, assumed to be invariant. This dedifferentiation might change our ethical self-understanding as a species in a way that could also affect our moral consciousness – the conditions, that is, of nature-like growth as the authors of our

[164] F. Fukuyama, op. cit., p. 172.

> own lives and as equal members of the moral community. Knowledge of one's genome being programmed might prove to be disruptive, I suspect, for our assumption that we exist as a body, or, so to speak, "are" our body, and thus may give rise to a novel, curiously asymmetrical type of relationship between persons.[165]

According to Habermas, genetic enhancement is morally problematic because it takes away our roles of authors of our lives due to the fact that our genetic make-up is deliberately decided upon by individuals other than ourselves. This puts us in asymmetrical relationships of creative power, which might have far reaching consequences for the way in which we perceive ourselves, other people and ultimately our entire species.

In order for Habermas's argument to be successful, it needs to prove that the dedifferentiation that he refers to is something that is inexorably linked to genetic enhancing technologies and that it does not occur otherwise. Now, it appears that this is not exactly the case. First of all, parents make all sorts of decisions regarding the composition of their future child's genome by selecting specific life partners and a certain moment for procreation. We know, for instance, that advanced maternal age increases the risk for Down syndrome.[166] Secondly, not only that parents act on the configuration of their offspring genome, but they can also influence their gene expression by choosing between medically assisted and non-assisted reproduction or simply by embracing certain lifestyle components before or during the gestation period. These two elements that I have just mentioned act, at the epigenetic level, on the way in which specific genes are turned on or off. Thus, research shows how assisted reproductive technologies increase the risk of imprinting disorders, such as Beckwith-Wiedemann syndrome and Angelman syndrome.[167] Similarly, the epigenetic mechanisms of the future child are influenced by both maternal and paternal lifelong nutritional and toxicological exposure, as well as by the maternal diet, supplementation and drug

[165] Jurgen Habermas, *The Future of Human Nature* (Cambridge: Polity, 2003): 42.
[166] P. W. Yoon, S. B. Freeman, S. L. Sherman, L. F. Taft, Y. Gu, D. Pettay, W. D. Flanders, M. J. Khoury, T. J. Hassold, "Advanced maternal age and the risk of Down syndrome characterized by the meiotic stage of chromosomal error: a population-based study", *American Journal of Human Genetics* 58 (3) (1996): 628-633.
[167] Eamonn R. Mahler, Masoud Afnan, Christopher L. Barratt, "Epigenetic risks related to assisted reproductive technologies: Epigenetics, imprinting, ART and icebergs?", *Human Reproduction* 18 (12) (2003): 2508-2511.

regimen during pregnancy.[168] Thirdly and putting aside the genetic and epigenetic say that parents have with respect to their children, it is important to acknowledge that they also provide most of the environment in which their offspring will be brought up. Finally, the simple fact that there *is* parental choice with respect to reproductive matters shows that there is a lack of independence in this area from the very beginning. As such, parents will influence their children's genetic make-up either by choosing or refusing to choose it. The mere possibility of altering genes annihiliates independence and the self-authorship of one's life. Even if parents abstain, they still make a choice. Given these considerations, I argue that Habermas's objection to medical enhancement is not justified.

One line of criticism against medical enhancement that is similarly focused on the potential disruption of parent-child relationships comes from Michael Sandel. According to Sandel, children should be appreciated as gifts,

> not as objects of our design or products of our will or instruments of our ambition. Parental love is not contingent on the talents and attributes a child happens to have. We choose our friends and spouses at least partly on the basis of qualities we find attractive. But we do not choose our children. Their qualities are unpredictable, and even the most conscientious parents cannot be held wholly responsible for the kind of children they have. That is why parenthood, more than other human relationships, teaches what the theologian William F. May calls an "openness to the unbidden."[169]

Following May, Sandel differentiates between two types of love that parents can nurture for their offspring. On the one hand, accepting love 'affirms the being of the child.'[170] On the other, transforming love 'seeks the well-being of the child.'[171] In order for the best interest of the child to prevail, there needs to be a good balance between accepting and transforming love. Whenever this

[168] James P. Curley, Rahia Mashoodh, Frances A. Champagne, "Epigenetics and the origins of paternal effects", *Hormones and Behavior*, Volume 59, Issue 3 (2011): 306-314.
[169] M. Sandel, op. cit.
[170] M. Sandel, op. cit.
[171] M. Sandel, op. cit.

equilibrium is lost, parents may slide either into indulgence and neglect by emphasizing accepting love, or end up rejecting the child if their main goal is to transform her.

Similarly to Habermas's objection, Sandel argues that parents do not normally choose their offspring. As I have already shown earlier in this section, parents do, in fact, decide on many of the genetic, epigenetic and environmental factors that will jointly determine the kind of person their child will grow into. Turning to the issue of parental love, it seems that transforming love cannot constitute a strong reason to deter prospective parents from enhancing their children. Sandel himself admits that 'improving children through genetic engineering is similar in spirit to the heavily managed, high-pressure child-rearing that is now common.'[172] Although, according to him, this fact cannot vindicate genetic enhancement, it does in fact show that the main problem lies within the hyper-parenting trend. Given this, I argue that it would ultimately be unfair to object to enhancing technologies when the real issue lies somewhere deeper.

Sandel's criticism of genetic engineering takes on a stronger form when applied to accepting love. Thus, in the advent of pre-natal genetic enhancement, modifying our children may stop us from accepting and enjoying the given and, ultimately, the being of the child herself, free of any of our projections. As a reply to Sandel, Frances Kamm starts from the assumption that love is always felt for a particular and, as such,

> before the existence of a person, there is no one with certain characteristics that we have to accept if we love him and do not want to impose undue burdens necessary for changes. Hence, not accepting whatever characteristics nature will bring but altering them ex ante does not show lack of love. Nor can it insult or psychologically pressure a person at the time changes are made the way ex post changes might. This is because no conscious being yet exists who has to work hard to achieve new traits or suffer fears of rejection at the idea that they should be changed.[173]

[172] M. Sandel, op. cit.
[173] Frances Kamm, *What is and is Not Wrong with Enhancement?,* KSG Working Paper No. RWP06-020 (May 2006), available at SSRN: http://ssrn.com/abstract=902372 : 28.

In Kamm's view, Sandel's worry that enhancement might undermine accepting love by making parental love contingent upon specific characteristics of the child is an instance of the distinction between 'caring to have' and 'caring about'. Thus, according to her, 'one can know that one will care about someone just as much whether or not she has certain traits and yet care to have someone, perhaps for their own sake, who has, rather than lacks, those traits.'[174]

It follows from all of the above that Michael Sandel's objection against human enhancement on the grounds that it disrupts a normal parent-child relationship can be satisfactorily answered. Nonetheless, his view on parenting and genetic engineering can be easily integrated into his wider line of criticism against medical enhancement, focused on the human desire for mastery and analyzed in the next section of this chapter. I have presented his take on the changes brought by genetic enhancement to the parental bond here because his arguments represent a natural continuation of those put forward by Habermas. However, this particular objection formulated by Sandel does not have the same relation to human nature as the others in this section do. In this sense, his criticism of enhancing technologies is applicable whether the latter succeed or fail to destroy our nature.

Lastly, I will analyze now one more objection brought against human medical enhancement for its potential destruction of our human core, perceived as the means for the attainment of other goods. In this specific case, the good in question is the moral guidance that human nature could bestow upon us. According to this perspective, human nature lies at the foundation of our moral values. Leon Kass, one of the supporters of this view, does not claim that everything that is natural is also morally desirable, but does aim at deriving moral norms from the way in which human nature is set up. For Kass, human nature is roughly equivalent to normal species functioning, close to the interpretation offered by Daniels. In his own words, Kass argues that

[174] F. Kamm, op. cit., p. 28.

> only if there is a human "givenness", or a given humanness, that is also good and worth respecting […] will the "given" serve as a positive guide for choosing what to alter and what to leave alone. Only if there is something precious in our given human nature – beyond the mere fact of its giftedness – can what is given guide us in resisting efforts that would degrade it. When it comes to human biotechnological engineering beyond therapy, only if there is something inherently good or dignified about, say, natural procreation, the human life cycle (with its rhythm of rise and fall), and human erotic longing and striving; only if there is something inherently good or dignified about the way in which we engage the world as spectators and appreciators, as teachers and learners, citizens and worshippers, and as seekers of our own special excellence and flourishing in whatever arena to which we are called, only then can we begin to see why those aspects of our nature need to be defended against our deliberate redesign. We must move, therefore, from the danger of hubris in the powerful designer to the danger of degradation in the designed.[175]

Interestingly enough, Kass, in his independent work or as chair of the President's Council on Bioethics, does in fact derive moral norms from the characteristics of human nature. Allen Buchanan calls this attempt 'normative essentialism.'[176] To offer an example, in its *Report on Human Cloning and Human Dignity*, the Council declares that 'human reproduction is sexual',[177] offering the claim a strong normative dimension: 'sexual reproduction imbues all human beings with a sense of individual identity and of occupying a place in this world that has never belonged to another.'[178]

The idea that human nature might represent a set of moral guidelines can be questioned by the very characteristics that it departs from. As such, it is well known that the properties that define human beings, at large, are not only morally desirable. Some of them are unwanted, while still others can be considered morally neutral. Parenting, for instance, has evolved from a social setting in which women - who are more connected to the child through their biological make-up -were considered the main care-takers, to a different understanding of parenthood and of the responsibilities that it creates. Thus, many social welfare models nowadays include both a maternity, as well as a paternity leave, and it is not uncommon to encounter families in which child rearing is primarily the task of the father and not of the mother. It seems that, in this area, nature dictates a certain allocation of

[175] Leon Kass, "Biotechnology and our Human Future" in Sean D. Sutton (ed.), *Biotechnology: Our Future as Human Beings and Citizens* (Albany: State University of New York Press, 2009): 20.
[176] Allen Buchanan, "Human Nature and Enhancement", *Bioethics*, Volume 23 Number 3 (2009): 145.
[177] The President's Council on Bioethics, *Human Cloning and Human Dignity: An Ethical Inquiry* (Washington, D.C., 2002).
[178] The President's Council on Bioethics, *Human Cloning and Human Dignity: An Ethical Inquiry* (Washington, D.C., 2002).

roles. Given that the woman carries, delivers and feeds the baby in her first months of life, she is the best option for child rearing, from nature's point of view. However, this practice goes very much against gender equality and it undermines women's fair equality of opportunity. In a similar fashion to the parenting example, the in-group and out-group bias that is one of the fundamental characteristics of human beings is also natural, although not morally appealing. Racism, which, according to some neuroscientists, is hardwired into our brains,[179] is something that our liberal democracies do not take pride in and, moreover, are actively trying to counteract. In the end, it appears that nature and human nature, in particular, cannot act as a moral compass. We've accumulated the features that make us humans through accident rather than by purposeful design. Under no circumstance, could this set-up constitute a safeguard for morality.

In this section, I have presented the main objections to medical enhancement on the grounds that it may alter and eventually destroy human nature. Some of these objections started from the assumption that human nature was an intrinsically valuable good. Others perceived human nature as the means for preserving human dignity, our intimate relationships or the standards that guide our moral precepts. None of these lines of criticism proved to be successful and unanswerable in their attempt to raise a moral eyebrow with respect to human enhancement. I will proceed now from human nature to nature itself and I will analyze, in the next section, the charge of hubris that is often associated with enhancing technologies.

5. Hubris

Another criticism to which medical enhancement is prone to is that of interfering with nature in a hubristic way, which basically amounts to placing human beings in a creative position

[179] Jennifer T. Kubota, Mahzarin R. Banaji and Elizabeth A. Phelps, "The neuroscience of race", *Nature Neuroscience* 15 (2012): 940-948.

that they have never occupied before. This argument is closely related to the objection regarding human nature that I have just presented. If in the previous section humans were mainly perceived as the objects of enhancing technologies, here they are regarded from the opposite side of the creation process, namely, as creators. In this case, the worry is that individuals will develop a wrong attitude toward nature and toward their place in it. They will fail to accept the given and to embrace life and its offerings as gifts. Michael Sandel, for instance, views genetic enhancement as 'a kind of hyperagency', 'a Promethean aspiration to remake nature', 'a threat to banish our appreciation of life as a gift, and to leave us with nothing to affirm or behold outside our own will.'[180] Leon Kass also adheres to this argument, emphasizing the importance of the given, the given in our nature, as well as that in other forms of life:

> Most of the given bestowals of nature have their given species-specified natures: they are each and all of a given *sort*. Cockroaches and humans are equally bestowed but differently natured. To turn a man into a cockroach—as we don't need Kafka to show us—would be dehumanizing. To try to turn a man into more than a man might be so as well. We need more than generalized appreciation for nature's gifts. We need a particular regard and respect for the special gift that is our own given nature.[181]

First of all, as Frances Kamm pointed out, not everything that is natural is automatically good and should be honored as a gift. Painful genetic conditions and infectious diseases are natural, but rather than receiving them as valuable offerings, we rightfully try to prevent, treat and eliminate them as much as possible. Second, as hubris is associated with the desire for mastery, it is important to emphasize, as Kamm does, that the latter need not be necessarily bad. Thus, she plausibly assumes that we desire mastery as a means to some good ends, such as that of avoiding pain, for instance. However, even if this were not the case and mastery were to be pursued for its own sake, then, following Thomson and Scanlon, Kamm reminds us that 'the intentions and attitudes of an

[180] M. Sandel, op. cit.
[181] Leon Kass, "Ageless Bodies, Happy Souls: Biotechnology and the Pursuit of Perfection", *The New Atlantis* 1 (2003): 9.

agent most often reflect on the agent's character but do not determine the permissibility of his act.'[182] As such, even in this case in which the desire for mastery takes the most hubristic form, enhancement can still be morally justified.

6. Identity and authenticity

One of the dangers that have been linked to medical enhancement, especially at the individual level, is that of altering one's identity and authenticity. There is an abundant philosophical literature on personal identity and there are many rich models that aim to define it properly. In spite of this, there is not much consensus on what identity really is, nor on how it could be changed or maintained. It is this latter issue, namely, that of the persistence of personal identity over time, that becomes problematic in the context of enhancement. If an individual resorts to enhancing technologies that will ultimately change her physical, cognitive and/or moral make-up, will she remain the same person that she was before the enhancement took place? Carl Elliott has raised this problem almost 20 years ago, when the prospects and advances of science and technology were definitely not as promising as they are nowadays.

> What is worrying about so-called "enhancement technologies" may not be the prospect of improvement but the more basic fact of altering oneself, of changing capacities and characteristics fundamental to one's identity . . . Making him smarter, giving him a different personality . . . mean, in some sense, transforming him into a new person.[183]

Elliott's worries can be adequately answered by David DeGrazia. In his defense of medical enhancement, DeGrazia emphasizes the importance of self-creation and of the active implementation of one's ideal regarding the good life in any matter concerning authenticity and identity. Thus, being true to oneself should not only amount to the witnessing of one's personality

[182] F. Kamm, op. cit., p. 6.
[183] Carl Elliott, *A Philosophical Disease: Bioethics, Culture and Identity* (New York: Routledge, 1999): 28-29.

and behavior. It should not be merely passive, but also transformative. Personal identity is, in many cases, a complex layer of traits that might not all manifest at the same time and under similar circumstances. Some need more encouragement, cultivation and perhaps more self-confidence. As such, rather than undermining authenticity and severing the relationship that one has to oneself, enhancements may even strengthen these personal bonds and allow one's identity to present itself in its entire complexity.

> A person can be true to oneself even while transforming and even creating the person one is. One's self is not something merely waiting to be discovered, after all. To some extent, part of the human endeavor is deciding and trying to become who we want to be.[184]

Now, DeGrazia's argument concerning enhancement and its relationship to authenticity and personal identity can only apply to those situations in which one seeks an upgrade in order to actualize oneself according to one's conception of the good life. However, there is another type of worry that lures over enhancing technologies and to which DeGrazia's reasoning cannot provide an answer. In this sense, it has been argued that enhancement jeopardizes one's relationship with oneself because it might turn out to be 'an expression of societal norms that are morally problematic or oppressive.'[185] This is a serious objection, which, unfortunately, can also be backed up by empirical evidence. Breast augmentation surgeries, liposuctions, rhinoplasties or growth hormone treatments can all testify to this trend. Nonetheless, when enhancements are performed with the intention of aligning one's body, personality and/or behavior with an existing set of norms, it might still be the case that they end up promoting authenticity, as well as the development and display of personal identity. If the individual undergoing the enhancing procedure genuinely values norm compliance and her integration into the standards of her community, then enhancements cannot be blamed for destroying her authenticity or for transforming her into a different person that has

[184] David DeGrazia, "Prozac, Enhancement, and Self-Creation", *Hasting Center Report* 30, no. 2 (2000): 34.
[185] Niklas Juth, "Enhancement, Autonomy, and Authenticity" in Julian Savulescu, Ruud ter Meulen and Guy Kahane (eds.), *Enhancing Human Capacities* (Wiley-Blackwell, 2011): 34-49.

nothing in common with her pre-enhancing version. On the other hand, there might be the case when enhancements are sought purely for norm compliance, while norm compliance is not valued in itself by the enhanced individual. Unfortunately, this practice is widely spread when it comes to non-medical types of enhancement in particular. We can witness everyday women wearing high heels, when many of them would probably opt for more comfortable footwear. The same goes for weight-loss diets or different beauty treatments. Similarly to many other objections to medical enhancement, the problem that is being identified here does not strictly and solely apply to medical attempts of self-improvement. It easily covers the non-medical arena as well. As such, it does not show that there is something wrong with medical enhancement, but rather with the prevalence of certain societal norms and attitudes.

7. The misprioritization of resources

Given the scarcity of resources that characterizes all our enterprises, pursuing enhancements, which are not necessary for a good state of health, to the detriment of treatments and preventative measures, is morally problematic. The core of this objection lies in the idea that enhancements might tempt us to fund projects that are less worthy than others. In the end, this will leave most of us worse off than otherwise.

The micro and macro-allocation of resources regarding health and health care have already been discussed by the existing literature. Thus, there are many schemes of distribution that can ensure an efficient and fair granting of funds among different medical procedures and stakeholders. Norman Daniels, for instance, extends Rawls's theory of justice to the areas of health and health care and provides compelling answers to some of the most stringent questions that could be raised in this field.[186] Similarly, the empirical evidence regarding resource allocation in health indicates that,

[186] Norman Daniels, *Just Health: Meeting Health Needs Fairly* (Cambridge: Cambridge University Press, 2007).

at least at the current moment, enhancements do not jeopardize the focus needed to tackle some of the biggest killers of our time. The US National Institutes of Health, for instance, have granted most of their 2014 funds to the following areas, which are also correlated with the biggest health risks: cancer, infectious diseases, brain disorders, rare diseases, pediatric disorders, HIV/AIDS, aging, mental health, cardiovascular, emerging infectious diseases, neurodegenerative, heart disease, lung disease, hematologic diseases.[187] It follows that the misprioritization objection to human medical enhancement can be neither theoretically, nor empirically supported. Furthermore, this line of criticism does not directly target human enhancement, but rather certain ways of practicing it, and it ultimately reminds us that how much society is willing to spend on enhancing procedures should be responsive to a theory of a fair overall distribution of resources.

8. Increasing the already existing inequalities and possibly creating new ones

Similarly to any emerging technology, the distribution of medical enhancements is believed to be limited by financial constraints. This means that they will not be readily accessible to a wide audience – at least, for some time after their launch - , but rather to a few that could afford their costs.

> Thus inequalities of wealth will be turned into genetic inequalities, and the clock will be turned back on centuries of struggle to overcome the privileges of aristocracy. Instead the present generation of wealthy people will have the opportunity to embed their advantages in the genes of their offspring. These offspring will then have not only the abundant advantages that the rich already give their children, but also whatever additional advantages the latest development in genetics can bestow on them. They will most probably therefore continue to be wealthier, longer-lived and more successful than the children of the poor, and will in turn pass these advantages on to their children, who will take advantage of the ever more sophisticated genetic techniques available to them. Will this lead to a *Gattaca* society in which "Invalids" clean toilets while "Valids" run the show and get all the interesting jobs?[188]

[187] The US National Institutes of Health, *Estimates of Funding for Various Research, Condition, and Disease Categories* (2014), available at http://report.nih.gov/categorical_spending.aspx Last accessed: June 2015.
[188] Peter Singer, "Shopping at the Genetic Supermarket" in S. Y. Song, Y. M. Koo and D. R. J. Macer (eds.), *Asian Bioethics in the 21st Century* (Tsukuba, 2003): 143-156.

Peter Singer's principal worry is that mostly the wealthy will be able to purchase medical enhancements. In time, this will lead to the existence of societies in which overlapping genetic and economic inequalities become the norm, with grim prospects for the improvement of the worse off. There are several problems with Singer's argument. Firstly and most importantly, enhancements need not constitute a threat to an equal distribution of resources, be they of an economic or of a genetic nature. Moreover, enhancements might even contribute to closing different inequality gaps. Thus, by resorting to enhancing technologies, the people who are worse off in terms of the genetic endowments that are mostly valued on the job market will be able to improve many of their capabilities. As a consequence, not only will they have managed to escalate the genetic ladder, but they will also acquire benefits of a socio-economic type as well.

Second, the distribution problem that Singer's argument rests on might not pose an insurmountable threat to the wide spread of medical enhancements or of the benefits arising from their use. There are two kinds of scenarios that one can envisage in this respect: one that is pessimistic and another of a more optimistic nature. I shall start with the latter. Imagine that tomorrow an enhancing device capable of raising your IQ up to 25% of its current value is available for purchase in drug stores all around the world. The price of the device will definitely be much higher than in a year or two from now. What is relevant for this discussion, however, is how big the initial price of the enhancement is as opposed to other technologies available on the market and to the average income. If the cognitive enhancing device is comparable to most newly launched technological gadgets, we can reasonably assume that although it will not be immediately purchased by all those that are interested in it, eventually its cost will go down and more people will be able to afford it. At least, this is what the trend looks like in most countries when a new smartphone, computer or tablet enters the market. Now, one might rightfully argue that the enhancement of our capabilities is likely to impact our lives in a more fundamental way than phones or computers could

ever do. This is debatable, but not completely groundless. Also, given the fact that the cognitive enhancement that I have just mentioned is not only a new device, but rather a new technological niche, it might be the case that the costs for its purchase would be so high that only a few could be able to acquire it. Ultimately, when we are talking about a new smartphone or computer, we are referring to one particular model in a relatively long line of phones and computers. On the other hand and as far as enhancements are concerned, the very first enhancing devices targeting a certain human capability will be just that: one single device, with no alternative for purchase. Thus, these are the coordinates under which the biggest problem regarding the access to enhancing technologies is being shaped. In this context, the question that deserves most of our attention is the following. Given that the cost for the first major enhancing devices is likely to be very high, would it be preferable to (a) let the market follow its due course, even if this means that only a few will initially receive the enhancement and the rest will have to wait for an unspecified amount of time; (b) limit everyone's access to enhancement due to egalitarian concerns; (c) delegate the fair distribution of enhancements to the state?

As, at a first glance, point (b) seems to be the most radical, I will address it first. The idea that no one should receive the new enhancing device if not everybody or, more moderately put, most of the interested parties can access it, is a standard levelling-down approach to distributive justice. Striving for equality for the sake of equality might not always be the optimal solution. In the specific case of enhancing technologies, however, it could be argued that equality is to be preferred, given that the consequences of enhancements might permeate almost, if not all areas of one's life and be tightly connected with a host of personal, as well as socio-economic benefits. In other words, allowing for inequality to occur in the distribution of enhancements might lead to many other inequalities and to an unequal society overall. If enhancements would only bring benefits to the enhanced person alone, these worries should materialize into incentives for either limiting the access

to enhancement or place its distribution under public supervision. Interestingly enough, this is not the case. Many types of enhancements and, especially the cognitive and moral ones, do not only affect the life of the enhanced individual. A morally enhanced person, for instance, will aim at developing fair relationships with the others and with herself. In a similar vein, the radical cognitive enhancement of one individual alone might solve many of our collective problems, like finding new sources of renewable energy or innovative means for ensuring a fair distribution of resources. Due to the specific nature of enhancing technologies and of the benefits they bring, inequalities in the access to enhancing devices need not result in other types of inequalities and, moreover, they can create the potential for promoting social justice. As such, it seems that denying enhancements to the few that could afford them might leave everyone worse off than otherwise.

Now, if giving up enhancements altogether is not a viable option, let us consider whether it would be preferable to delegate their distribution to the state or assign it to the constraints of the market. The shadow of eugenics still lures over many proposals that involve the state's input in the fields of reproduction and genetics, creating a strong public moral sentiment against government intervention. Letting this issue aside, which is ultimately a matter of public perception, the state's involvement in the distribution of enhancements can be problematic on other grounds. The fact that the state ensures the access to enhancing technologies means that there is one 'centralized decision fixing the future of human type(s).'[189] This might undermine genotypical and phenotypical diversity and, in time, it will end up impoverishing our societies, as well as our species. Running a genetic supermarket, which is Nozick's suggestion, might prevent this from happening, as it would receive a great deal of inputs from a diverse body of decision-makers.

In the end, it seems that point (a), which is focused on a market-oriented approach to the distribution of enhancements, is the least troublesome perspective on this issue. Although it has its

[189] Robert Nozick, *Anarchy, State and Utopia* (New York: Basic Books, 1974): 315n.

drawbacks, which reside mainly in the fact that it is highly likely that a lot of people will not be able to access enhancements once they are produced, it also has its net advantages over the other proposals. First, the enhancement of a few is overall better than no enhancement at all. Second, in order to ensure diversity, market constraints or a market-like setting are to be preferred to unmediated state intervention. Similarly to the misprioritization objection, this line of criticism is not directed against human enhancement *per se*, but against the way in which its distribution might be put into practice. It is an objection only against making enhancements available on a market basis under currently existing unjust circumstances. Basically, these concerns highlight the fact that the distributive aspects of enhancing technologies should respond to the overall considerations of social justice.

Conclusion

In this chapter, I have presented the main arguments that are usually formulated against human medical enhancement. In many cases, the moral attitudes arising from discussing the implications of enhancing technologies turned out to reveal certain ethical problems existing at deeper social levels and that were brought back to the surface by enhancement debates. In other cases, enhancements and their promises were misunderstood, distorted by the 'yuck factor' and, consequently, falsely problematized. Still in others, enhancing technologies appear to be the solution to the concerns raised by their very critics. I have analyzed here the strongest and most frequent objections brought against human enhancement. None of them was left unanswered and, as such, I conclude this chapter with the thought that human medical enhancement, in itself, does not constitute a reason for moral worry.

CHAPTER 5

Future Generations and Genetic Enhancement

If you don't know where you are going,
any road will get you there.
(L.Carroll)

This chapter will cut to the core of the main topic of my dissertation by analyzing the way in which enhancing technologies that are aimed at modifying the genome or gene expression of the individuals within the present generation may influence the potential interests of future generations. So far, my strategy has been to clarify my working concepts - which are recurrent and of great significance in the literature –, investigate their moral underpinning and afterwards realign them in such a way as to address the question that is really at stake here: *how should genetic interventions be distributed among the current people without disregarding the well-being of future generations?*

I have previously defined the notion of genetic intervention and classified it into different categories, according to its time, object and aim. I have identified and discussed the moral vulnerabilities to which many types of genetic interventions could be prone and then I have approached, in more detail, those genetic manipulations that could have the greatest impact on the life of distant generations. In this sense, in a previous chapter, I have presented an argument regarding the justifiability of germline engineering from an intergenerational perspective. Now, after I have already clarified the meaning and exposed the moral challenges of enhancement, the most sensitive and controversial type of genetic intervention, as classified according to its aim, I will

proceed to looking at the way in which enhancing procedures in the current generation may affect future people.

The first question that my approach could raise is the following: why would I spot enhancement as a relevant concern for our intergenerational relations out of all the types of genetic procedures that we might be able to perform and disregard all the rest, namely treatment and prevention? The main reason for which I opted for this course is due to the fact that the very nature of these distinct medical procedures gives birth to different sets of moral duties that we could have toward our contemporaries and descendants. Genetic treatments are meant to alleviate the pain and suffering associated with an existing, actual harm. Preventative measures, on the other hand, tackle the probable occurrence of a future harm. One of the minimal requirements of any moral code is to avoid inflicting harm when it is on our power to do so and there are no high personal costs attached. It *is* in our power to avoid harm – understood, in this context, as physical or physically-grounded harm - through genetic treatments and preventative measures. When it comes to enhancement, however, there is no actual, nor potential harm that we need to take into account. Enhancement upgrades someone's capacities from good to better. It is a supererogatory act rather than a stringent moral demand. One might rightfully argue that benefitting in itself - and not solely avoiding the occurrence of harm - cannot be supererogatory, but a real moral duty. This statement is highly debatable. The principle of beneficence in health care cannot stand on very solid grounds due to the fact that the medical profession lies at the intersection of different claims from various stakeholders, within a general background of resource scarcity. For once, Clouser and Gert claim that medical beneficence would ultimately clash with the duty of impartiality:

> How could benefiting others ever become a moral duty required of everyone? After all, systematic considerations would convince us that impartiality is an essential feature of moral requirements. But

> the 'duty' of beneficence cannot be impartially followed. That is, it is impossible for us to do good toward everyone, impartially, all the time.[190]

Physicians are not only the benefactors of their patients. They also act as the stewards of medical resources. This stewardship 'concerns a society's responsible use of medical resources' and

> is best understood as a duty that applies in a space between the obligations of health care providers to provide beneficent care to their patients on the one hand and the obligations of citizens to bring about and support a just health care system on the other.[191]

In this sense, enhancement's characterization as supererogatory or as a duty toward our contemporaries matters as a means for prioritizing our scarce resources.

Now, given its centrality in determining the moral urgency with which we should perform the three types of medical procedures that have been previously mentioned, it is worth discussing in more depth what harm really is. There are many views and multiple frameworks under which one may analyze the concept of harm and what may count as harm. This statement is true even if I am solely taking into account the harms targeting our physical bodies. Thus, in a broader understanding, refusing to enhance might constitute an instance of harming someone by making her worse off than she might otherwise have been. Unarguably, better is indeed better than good. This is the comparative account of harm. In the context of genetic engineering and independent of the other objections that have been formulated against it, the comparative model does not prove to be a very useful tool because it may lead to infinite regressions. As such, any type of enhancement may top a previous enhancement, which means that unless an individual is constantly enhanced she will be harmed. In order to avoid this problem, I will embrace the non-comparative account of harm and, more specifically, I will use as a main reference point Elizabeth Harman's sufficient condition for

[190] K. Danner Clouser and Bernard Gert, "A Critique of Principlism", *Journal of Medical Philosophy* 15 (1990): 228.
[191] Lynn A. Jansen, "Between Beneficence and Justice: The Ethics of Stewardship in Medicine", *Journal of Medicine and Philosophy* 38 (2013): 50.

harmfulness: 'One harms someone if one causes him pain, mental or physical discomfort, disease, deformity, disability, or death.'[192] What unites all these items on Harman's list is the idea that

> an action harms someone if it causes the person to be in a bad state. Bad states are understood as states that are in themselves bad, not bad because they are worse than the state the person would otherwise have been in.[193]

Not treating an illness does cause the person bearing the illness to be in a bad state. Similarly, abstaining from preventing a preventable condition still causes its carrier to be in a bad state. It is not an actual and immediate bad state, but a bad state, nonetheless. The fact that this type of harm is bound to occur at an (in)definite future time does not make it less harmful. Consequently, this temporal feature should not erode our moral duty to prevent such bad states if we have the means to do so and no significant costs are incurred on our side.

The type of harm that I have been referring to until now is a bad state concerning one's health status. When we are discussing genetic engineering, it is normal for our intuitions to point us toward health as a primary object for concern. However, it might be the case that genetic procedures could influence the outcome of many other non-health related processes and events, which can be considered objectively and non-comparatively bad. To offer an example, let us look at cognitive enhancement. Even if cognitive enhancement will not leave us better off as far as our health is concerned, it may very well touch upon other problems that we are facing, as a collective: environmental degradation, designing safe artificial intelligence, combatting terrorism under all its forms, decoding complex diseases, understanding and defeating aging, just to name a few. While some of these harms are of an immediate character, others, like environmental degradation or terrorism, are of a peculiar nature. They cannot be completely considered immediate harms, nor

[192] Elizabeth Harman, "Harming as Causing Harm" in Melinda A. Roberts and David T. Wasserman (eds.), *Harming Future Persons: Ethics, Genetics and the Nonidentity Problem* (Netherlands: Springer, 2009): 140.
[193] E. Harman, op. cit., pp. 140-141.

non-immediate. I believe they could best be described as cumulative. Thus, as time goes by, the lack of natural resources becomes increasingly worrying due to the fact that their bundle continues to shrink. Similarly, the negative effects of pollution and of other human activities on Earth's atmosphere accumulate in time. On a similar note, terrorism may also be considered a cumulative type of harm. As science advances in understanding life and everything that surrounds it, our potential for destruction also increases. This means that more options are opened to those interested in pursuing terroristic means in order to achieve their goals. On top of everything else, the magnitude of the produced harm can also rise. Think about synthetic biology and the way in which its success in the betterment of individual human lives can misfire, leading to biological catastrophes that might be very hard to contain. Unleashing dangerous viruses, created from scratch or re-engineered in order to maximize their destructing potential, may affect a large number of people in a very significant kind of way. As such, it is not unreasonable to assume that the harms associated with these two distinct phenomena – environmental degradation and terrorism - become more stringent for the future people, as compared to the current people. Nonetheless, this does not mean that the latter do not feel any kind of distress. The present generation is also affected, but at a lower level of intensity.

There are collective harms within the current generation as well that could be ended via cognitive, moral or even physical enhancement: murders and violence, cancer and other debilitating diseases, aging. Should we not attempt to solve these as well through the indirect route of enhancement, by creating more intelligent, more physically abled and more moral human beings? We might very well pursue this path, but nothing can guarantee that it will work better than simply facing the real issues head-on. It would be far from realistic to rely on genetic enhancement to find the key to our collective problems, be them present or future. What enhancement could do is set us on a general trajectory which might prove to be beneficial for solving or simply for speeding up the

process of solving the difficulties that we are facing now or in the future. For instance, cognitive enhancement, in and of itself, will not be able to solve the problem of environmental degradation. But it might just be one of the main ingredients in that attempt. The world's developmental trajectory

> is a rough summary of the way the future will unfold over time. The summary includes various facts about the world that matter from a macro perspective, such as how rich people are, what technologies are available, how happy people, how developed our science and culture is along various dimensions, and how well things are going all-things-considered at different points of time.[194]

To sum things up, it appears that treatment and prevention are linked to types of harms that affect more the current generation,[195] while enhancements deal with harms that especially target future generations. In this context, there are two questions worth asking: (1) How should the present generation approach genetic engineering in such a way as to avoid inflicting unnecessary harm on its members? (2) How should the present generation approach genetic engineering in such a way as to avoid inflicting unnecessary harm on future people? In order to answer these questions, it is worth stressing out one important detail. The fact that treatment and prevention affect *more* present generations than distant people should, by no means, amount to saying that these medical procedures bear absolutely no influence on the potential well-being of future generations. The reality is that they do. Think about antibiotic use or immunizations that accelerate the evolution of viruses and bacteria. Overall, they strengthen the pathogens at the expense of their hosts and leave the immune systems of future people worse off than otherwise. So, in this context, how should the current generation approach this kind of procedures and their effects for the known or unknown future? Basically, this is what question number (1) is asking. As I have previously argued, the current generation has no real moral choice when it comes to treating and preventing the health conditions

[194] Nicholas Beckstead, *On the Overwhelming Importance of Shaping the Far Future* (PhD Thesis) (Rutgers University, 2013).
[195] I disregard here whether treatment and prevention are conducted at the level of the germline or of the somatic cells. This distinction, its moral relevance and relationship with the interests and well-being of future generations has been discussed in a previous chapter. For the present purposes, only the aim of the genetic intervention matters and not its direct object.

of its members. Unless treatments and preventative measures are offered, the latter would be exposed to unnecessary harm. I would like to emphasize the notion of *unnecessary* harm. When looking at the well-being of a whole community, which, to makes matters worse, might even not be temporarily congruent, it is not feasible to avoid all instances of harms that are bound to occur. As such, one needs to make certain decisions that will eliminate some types of harm, while it will not touch upon others. It is very hard, if not impossible, to quantify the concepts of harm and harmfulness. Both rest on subjective evaluations that might prove hard to reconcile and gather under a common denominator. At the collective level, however, there might be some useful proxies for guiding our moral decisions: the amount of people at risk for a certain type of harm correlated with the intensity of the pain or discomfort that are associated with the harm, as averaged out from individual reporting. Although empirics cannot act as precedents for moral decisions, the current health care system does use a system based on proxy reasoning in order to distribute its resources: the QALY (quality-adjusted life year) model. Following a utilitarian cost-benefit analysis, QALYs are focused on the number of years that are added by a certain medical intervention, correlated with their associated state of health. A value of 1 is assigned to perfect health and 0 to being dead. Although the QALY system has its drawbacks, many of which have been widely discussed in the literature dedicated to health care, it is, nonetheless, a principled way to approach the sensitive issue of resource distribution under conditions of scarcity. I am not arguing in favor of the QALY system here, but rather in favor of a methodic way to distribute health care resources. Depending on its exact configuration, the method might not be perfectly just in itself, as it might lead to the conscious avoidance of certain types of harms. However, it will at least strive toward ameliorating other harms, which may be more stringent and/ or more widespread, while resting on solid procedural grounds that could reasonably be accepted by reasonable people.

So far, I have explained the reasons for which this chapter is dedicated to exploring the implications of genetic enhancement, and not of other genetic interventions, on the lives of future generations. Thus, after addressing the *why* question – why enhancement? –,the next step is focused on the *how*. How can enhancing genetic technologies touch upon the interests and well-being of the yet unborn people? Most of the discussion surrounding this issue is of a speculative nature. This is unavoidable, given the fact that the subject at hand is loosely connected with the empirics. There are many variables at play accounting for empirical facts that might either be completely unknown or solely partially defined at this point. Ultimately, it is the future that is being debated here. However, these variables cannot be ignored due to their centrality in understanding the relation between genetic enhancement and future generations and also in constructing arguments that can best approximate the terms of this relationship. Because this part of the dissertation is probably the most conjectural, it is important to present now in more detail the methodology that I am using in order to answer the *how* question.

The relationship between *is* and *ought,* between facts and normative theory, is often described through a succinct, though comprehensive maxim, which reminds us that '*is* does not imply *ought*.' Basically, what the maxim reads is that it is not possible to derive *ought* solely from *is*. It should, nonetheless, be acknowledged that empirical premises do make their own significant contribution to normative arguments. This latter aspect is especially relevant when it comes to bioethics and applied political theory. In these particular fields, which aim at applying normative theories to some very well-defined empirical questions, facts are crucial for the validity of the resulting arguments. Very interestingly, nonetheless, these crucial facts are not always easy to pinpoint. Through its focus, bioethics is many times oriented toward identifying the moral challenges associated with emerging technologies. Many of these emerging technologies are in their infancy, which can be conceptual infancy or the very first stages of practical development. In such cases, relying on facts becomes

problematic for the simple reason that we do not know what the future will actually bring. This is also the main methodological concern that I am dealing with right now. The way in which I intend to go about it is the following. I will base my arguments regarding the relationship between genetic enhancement and future generations on assumptions that combine both empirics and normative considerations that could be considered reasonable by most reasonable people. In order to arrive at these empirical assumptions, which, as I was mentioning earlier, are far from being unquestionable, I will rely on a clear non-ambiguous set of facts that depict the world as it currently is. Basically, my methodological journey starts from a solid place that depicts how the world really is, it proceeds to an account of how the world could be in the future given its current configuration and, finally, it arrives at its end point, namely, how certain areas within our future world ought to be configured. Thus, I insert a *could be* in between *is* and *ought*, while I also give due consideration to the clarification of my normative premises.

Many questions that have been raised so far in the bioethics and applied political theory literature can be answered in more than one way, depending on how *could be* is conceived and on which empirical assumptions are embraced. Let me offer an example that seems perfectly molded for the situation at hand: cognitive enhancement. Is cognitive enhancement something that we ought to pursue or not? If yes, how should we go about it? According to one view,[196] cognitive enhancement will diminish the cognitive diversity of the human species, in the long run. According to another position[197], cognitive enhancement will eventually lead to an increase in human cognitive diversity. Based on these two opposing empirical assessments regarding the development of cognitive enhancing therapies, one arrives at two distinct conclusions with respect to their effects on

[196] Chris Gyngell and Thomas Douglas, "Stocking the Genetic Supermarket: Reproductive Genetic Technologies and Collective Action Problems", *Bioethics* (2014): 241-250.
[197] Chris Gyngell and Simon Easteal, "Cognitive Diversity and Moral Enhancement", *Cambridge Quarterly of Healthcare Ethics* 24 (2015): 66-74.

society. In the end, these probable social effects are the main determinants of the moral challenges associated with the large scale practice of cognitive enhancement. Most importantly, they lay at the very core of the normative recommendations that could be made in this field. Thus, unfortunately, if these empirical effects are wrongly construed, then the normative component will turn out to be far from accurate.

Now, one question that could legitimately be asked in this context is the following: when there is no particularly convincing evidence to attest for the probable existence of a certain future trend, how does one know which side to pick? In other words, in the absence of sufficient empirical proof, how does one conceive of the *could be*? One way out of this difficulty would be to simply abandon the whole inquiry altogether. However, this is not feasible in most cases, as much of the research undergone in this area is targeting questions which may prove to be too disquieting if left untackled. Furthermore, no matter how distant the future is or seems to be, we have to prepare for it. A second possible approach around this methodological concern, which is also the approach that I embrace here, is to lay out all probable future scenarios and afterwards proceed in one of the two following ways. First and to be preferred when feasible, choose a certain course of events while justifying both the reasons for adopting it, as *well* as the reasons behind the rejection of all the rest. Second, if the previous method cannot be implemented it means that all future scenarios are, to varying degrees, likely to occur due to empirical ambiguity. In this case, uncertainties and biases could be overcome by presenting the future from the perspective of all these complementing scenarios. Although a loose normative assessment, this will at least be an accurate moral evaluation.

Having clarified this very important aspect of my inquiry, it is now time to face the *how* question that I have previously referred to: how does genetic enhancement impact the well-being of future generations? I identify four main areas through which genetic enhancement may come to influence the lives of the future people: (1) collective action problems; (2) impact on global risks; (3)

utopic singularity; (4) social configuration. The first three points will be addressed in the remainder of this chapter, while the fourth will be developed in the next chapter, dedicated to genetic enhancements and distributive justice.

1. Future generations, genetic enhancement and collective action problems

A collective action problem depicts the situation in which rational agents in pursuit of their own interest end up disadvantaging or outrightly harming every member of the collective through the synergistic effect of their actions. No one individual bears full responsibility for the occurrence of a collective action problem. Similarly, no one individual could solve such a problem on her own.

How do collective action problems relate to genetic enhancement and future generations? There are three ways through which these elements could be linked. The first is related to the type of genetic enhancements that individuals will use for themselves. The second concerns the choices that parents will make with respect to their children's genomes. Finally, there is the diversity of genetic enhancements or lack thereof that will influence whether collective action problems are likely to occur or not.

The combination between our natural and social environments, together with the pressure that they exert, make us value certain phenotypic traits more than others. Although there is broader consensus on which human characteristics are disadvantageous for their carriers, there is also a quite widespread agreement regarding the traits that are beneficial and worth having. In this context, the worry is that everybody will have the same genetic preferences for themselves and for their offspring and, as such, they will enhance in approximately the same way. As a consequence, much will be lost in terms of the diversity of the human types and traits. In a similar vein, individuals' genetic choices will be very much limited by the products available on the market. Thus, diversity can be impaired by the lack of a large range of enhancing opportunities. It is unlikely for this situation to last

indeterminately, but it does represent a well-established trend in the development of any new technology. First comes the technological breakthrough embodied in one or a limited number of prototypes. More models, together with the opportunity for customization and for exerting choice, follow afterwards. This course of events characterizes the progress of technologies that share a common background, which could be either the science or the engineering behind the product. Think about the evolution of personal computers, for instance. Each new model builds upon its older version(s) and it could generally be regarded as an improvement. However, although this model of technological development may be applicable to the area of human genetic enhancement, it might also be the case that the genetic enhancement of one type of human capability (cognition, mood, morality etc) relies on technologies that come to evolve separately in terms of their approaches and general know-how. In this scenario, a new technology is not just the improvement of a previous one, but a genuine and novel breakthrough in itself. Thus, the radical enhancement of one's memory may follow a different route than the enhancement of focus and concentration. Even if we are only discussing genetic procedures here, it might just be the case that different clusters of genes and different gene interactions require unique problem-solving techniques.

In their paper on collective action problems and reproductive genetic technologies, Gyngell and Douglas use three examples to illustrate their concerns: immunization, height and cognition.[198]As this chapter is concerned with genetic enhancement only, I will not address here the issue of immunization, which counts as a preventative measure. Genetic procedures that are intended to tackle a health concern – either by treating or preventing it – have already been discussed in the chapter on future generations and germline engineering. The main challenge there was also diversity, but, in that context, it was perceived only from the angle of health and physical well-being. Now, the focus is on diversity as a component of the good life, the good life being

[198] C. Gyngell and T. Douglas, op. cit.

extended to other valuable non-health related things, such as cultural enjoyment, technological advancement for increased individual well-being and the construction of an optimal social environment. As such, height and cognition do constitute proper topics for this particular discussion. They are both enhancements and, on top of it, they embody different types of goods that individuals are interested in acquiring: positional and non-positional.

There are many reasons for which parents would choose tall children if given the opportunity. For once, tall people are more likely to have stable relationships.[199] Furthermore, being tall has been positively correlated with an increased income and better career prospects, even when education has been controlled for.[200] Finally, height has also been associated with subjective well-being, tall individuals being advantaged in this respect as well.[201] Now, the question that is at stake here is whether height matters in itself, or only being taller than others is what really counts. In other words, is height a positional good? We know that extreme tallness is linked with a host of health problems. On average, tall people have a reduced lifespan when compared to shorter people.[202]In this context, in which being very tall negatively affects one's health, it might just be the case that the significance we place on height as a means for securing socio-economic benefits boils down to faring better than others. Thus, it is relative height that we care about. As a positional good, height can lead to an enhancing arms race from which the collective and each individual, as part of the collective, will be harmed:

> [E]ven if the means of height enhancement had no direct negative health consequences for the enhanced individual, such enhancements would nevertheless have costs, including the economic costs of the intervention itself and the costs of redesigning our building, vehicles and environment more generally to accommodate taller individuals. There may also be other environmental costs

[199] D. Nettle, "Women's height, reproductive success and the evolution of sexual dimorphism in modern humans", *Proceedings of the Royal Society B: Biological Sciences* 269 (2002): 1919 – 1923.
[200] Timothy A. Judge and Daniel M. Cable, "The Effect of Physical Height on Workplace Success and Income: Preliminary Test of a Theoretical Model", *Journal of Applied Psychology*, Vol 89 (3) (2004): 428 – 441.
[201] A. Deaton and R. Arrora, "Life at the Top: The Benefits of Height", *Economics & Human Biology* 7 (2009): 133 – 136.
[202] Thomas T. Samaras, Harold Elrick, Lowell H. Storms, "Is height related to longevity?", *Life Sciences* 72 (2003): 1781 – 1802.

> associated with height enhancements. In general tall people need to eat more food, require more fuel to travel, and consume more resources than shorter people. The creation of taller people could increase carbon emissions and increase the risk of dangerous climate change.[203]

As I was mentioning earlier in connection with the methodology employed in bioethics research, it is not always obvious how reliable certain empirical assumptions concerned with predicting the future are. In the case of height, Gyngell and Douglas's assumption is that parents would be willing to trade their children's health and its associated well-being in order to gain positional socio-economic advantages. However, when it comes to the example of cognition, they argue for exactly the opposite thought: that even if some genes may be associated with valuable cognitive skills, parents will decide to eliminate them in order to secure a good state of health for their offspring.

> Consider genes that predispose individuals to depression. Being prone to depression can make someone's life harder and less enjoyable. This may mean that, in a genetic supermarket, rational individuals would select against genes that predispose to depression. However, these genes may also contribute to valuable cognitive skills. For example, people who are predisposed to depression have been shown to have increased analytic skills.[204]

As these assumptions regarding the type of choices and trade-offs that parents would make with respect to the genetic configuration of their children cannot be both simultaneously true, one of them is wrong. Now, the question is which. In order to find out the answer, we need to expand our view beyond the field of genetic reproductive technologies and look at the entire bouquet of parenting techniques that are mostly employed in the parent-child relationship. Do parents generally give up their offspring's health in return for socio-economic benefits? Empirical evidence seems to point to the contrary. First of all, one could argue that good health is a prerequisite for a large variety of goods, including a satisfying career with good financial prospects. Thus, sacrificing health in return for other advantages might end up undermining all attempts of reaching one's goals. Second,

[203] C. Gyngell and T. Douglas, op. cit., p. 4.
[204] C. Gyngell and T. Douglas, op. cit., p. 6.

if parents valued their children's potential for future socio-economic gains more than their health and its associated well-being, then the world would be void of things such as family vacations and outings, play dates, cartoons, toys and video games[205] which serve no educational purpose and which boost none of our cognitive capabilities. Instead, it would consist of extended school hours, intense after school tutoring and a strict time monitoring that would allow no losses. As far-fetched as this seems, I even dare argue that a world in which only socio-economic advantages mattered would also be lacking students in the humanities, arts and some of the natural sciences, while the numbers of those interested in acquiring the skills associated with the highest paying jobs - computer science and technology - would sky rocket. You just need to take a look inside university campuses, parks and playgrounds, toy stores[206] to realize that children are not raised by their families with the sole goal of securing bright socio-economic prospects as adults. Parents' conception of the good life, which is plentifully diverse in our increasingly heterogeneous societies, does not stop at having children with financially rewarding jobs. There are many values that intersect within their decision-making process. Among them, health does certainly play a part, but it is debatable whether this part is a prominent one or not. Consider, for instance, the Deaf community.[207] From a medical perspective, which probably also overlaps with the position shared by the vast majority of the society, being unable to hear, completely or partially, constitutes a physical impairment that could negatively impact one's life and the richness of one's experiences. The Deaf community argues to the contrary, pointing to the alternative advantages arising out of the Deaf culture. As a consequence, many prospective parents

[205] There is a body of research which shows that playing video games may result in the improvement of different aspects of the human cognition. It is still debatable whether this enhancement can be attributed to the games themselves or to near-transfer effects. Please see Walter R. Boot et al., "Do Action Video Games Improve Perception and Cognition?", *Frontiers in Psychology,* 2 (2011) & A. C. Oei and M. D. Patterson, "Enhancing Cognition with Video Games: A Multiple Game Training Study", *PLoS One* 8 (3) (2013).

[206] According to a 2014 report of the Entertainment Software Association, Americans spent 15.4 billion dollars in purchasing games, as compared to 10.1 billion dollars in 2009 or 7 billion dollars in 2003. The report is available online: http://www.theesa.com/wp-content/uploads/2014/10/ESA_EF_2014.pdf Last accessed: April 23rd, 2015.

[207] The Deaf culture has been using for many years James Woodward's distinction between 'deaf' (the physical condition of being deaf) and 'Deaf' (the culture created within the deaf community). Please see Carol A. Padden and Tom Humphries, *Inside Deaf Culture* (Cambridge, MA: Harvard University Press, 2005): 1.

within this community have a very strong preference for their children to be born deaf in order to become Deaf, in spite of the fact that their inability to hear might leave them worse off on the job market. Some couples go to very great lengths in order to secure this, resorting to IVF treatments that would select the embryo that contains the genetic markers associated with deafness. What the example of the Deaf community shows is that it is very hard to pinpoint the absolute values that will guide society, in its entirety, in deciding on the genetics of the generations to come. Given this, it is reasonable to conclude that if a certain genetic modification is beneficial in some way, yet harmful in another for the individual undergoing it, we should not assume that there will be a homogeneity of opinions at the social level with respect to which course of events would be better to follow. The absence of an extreme decision-making pattern, be it tilted toward high homogeneity or high heterogeneity, means that there is no potential for the occurrence of collective action problems. It is of no particular significance, at the general level, whether height in itself can lead to such problems. But I believe that the example of height is illuminating in relation to the whole spectrum of cases that emulate it, in the sense that it acts as a useful prototype for distinguishing the areas that could reasonably be considered as prone to collective action problems from those that are not.

Now, how do cognition and its enhancement relate to group decision-making? Could cognitive enhancement lead to collective losses through the attainment of individual gains? As I have previously mentioned, it has been argued in the bioethics literature that cognitive enhancers could determine either a spike or a downfall in the cognitive diversity of the human species. According to the defenders of these theories, both scenarios would ultimately be conducive toward collective action problems stemming from the pursuit of individual benefits. If parents decide to enhance their children in such a way as to possess rare intellectual capabilities that are in demand on the job market, then cognitive diversity is bound to increase. This amounts to tapping on the entire potential of the human brain and to not discriminating between the desirability of different cognitive

functions. The fact that some valued capacities become rare in a society that is so advanced that one should only wish to have a specific trait in order to acquire it – that is, assuming that the distribution of genetic technologies complies with the requirements of social justice – also implies that those traits are also characterized by downsides that most individuals would not opt for. As this argument goes, if human cognitive diversity increases, then societies will become less empathetic and consensual. Heterogeneity in terms of rationalizing patterns would create less common ground for individuals to relate to each other and to successfully embark in deciding those issues that affect them all. This is the reason for which Gyngell and Easteal suggest having cognitive enhancement backed up by moral enhancement.[208]

Embracing the opposite point of view, Gyngell and Douglas argue that some genes encoding for cognitive capabilities may turn out to be either very popular or very undesirable, up to the point that most parents would end up making roughly the same genetic choices for their future offspring. As with most aspects of human genetics, human characteristics rarely come in perfect isolation and divisibility from other human features. This can basically be traced back to the way in which genes work. Apart from the cases in which one gene is associated with one phenotypic trait, genes can also act pleiotropically - meaning that a single gene determines more than one phenotypic characteristic -, or in clusters, which amounts to a certain phenotype being traced back to more than one gene. This is the simple explanation for which, from a genetic point of view,[209] a specific genotype can many times be comprised of an intertwined set of both beneficial and harmful phenotypic traits. When taking on the difficult task of making genetic choices for the yet unborn people (and, to a certain extent, even for oneself), individuals need to accept the fact that these choices will, most often than not, involve tradeoffs. In the case of cognition, what seems to be primarily at stake in the eventuality

[208] C. Gyngell and S. Easteal, op. cit.

[209] The coexistence of phenotypic advantages and disadvantages at the level of the same genotype cannot be explained solely by genetics, but also by evolutionary theory. I have presented the evolutionary explanation in the chapter on germline interventions and future generations.

of certain types of enhancements is mood and mental health. A large body of evidence accounts for the fact that depression[210] and bipolar disorder[211], for instance, are associated with an improvement in some cognitive functions. Basically and in tune with this whole argument, there are two sets of constraints that convergently act toward diminishing group cognitive diversity by either weeding out genes that are correlated with negative moods and relatively poor mental health or by actively promoting the spread of those genes which encode for highly valued cognitive capacities that do not require significant costs.

Needless to say, these opposing theories concerning the diversity of human cognitive capabilities or lack thereof cannot be both valid when applied to the same segment of time. However, it might just be the case that they complement each other and are able to coexist not simultaneously, but sequentially. As I have mentioned earlier in this chapter, it is not only the parents' preferences – be they negative or positive – that shape the decisions that they make with respect to the genetic endowments of their children, but also the availability of genetic technologies. Thus, as much as some parents would value a specific cognitive trait and be willing to choose it for their offspring, the lack of technological means to bring it about drastically impairs their capacity to act on their preferences. The diversity of opinions regarding the best life that could be found at the group level fails to be translated into a diverse decision-making process if technology does not keep up with social trends. It is highly likely that technology will not be able to satisfy absolutely all parental preferences concerning their children's cognition once specialized cognitive enhancers start to emerge on the market. In this context, due to a poor range of options, cognitive enhancement might represent a fertile ground for the development of a collective action problem associated with

[210] Please see P. W. Andrews and J.A. Thomson Jr., "The bright side of being blue: depression as an adaptation for analyzing complex problems", *Psychology Review* 116 (2009): 620-654 & R. Greifeneder and H. Bless, "Depression and reliance on ease-of-retrieval experiences", *European Journal of Social Psychology* 38 (2008): 213-230.
[211] Claudia M. Santosa et al., "Enhanced creativity in bipolar disorder patients: A controlled study", *Journal of Affective disorders* 100.1 (2007): 31-39.

decreased cognitive diversity at the level of the group. As more enhancing therapies become available, group cognitive diversity will be restored but the collective action problem will persist in one of the two following ways. A multitude of enhancing procedures will result in a heterogeneous population, which, according to Gyngell and Eastel, will be incapable of feeling mutual empathy and of getting along with each other. On the other hand, if the development of enhancing technologies takes too much time and individuals are already using the available enhancing resources to upgrade the cognition of their children, the group will become so homogenous up to the point that it will not even wish to improve the cognitive traits that are different from those already present. Reasoning patterns and heuristics could be so much reduced that alternatives to the dominant cognitive traits might not even be desired anymore and, as such, will fail to be designed.

In this context, it is worth asking one important question. We already established that cognitive enhancement and other types of improvements can affect human diversity either positively or negatively. However, this does not mean that all of these changes should result in collective action problems. They do constitute *prima facie* cases of collective action problems, but the causal link between the two variables is not as straightforward as it seems. Let us take each of the two possible scenarios that may constitute collective action problems and check whether they indeed are what they are purported to be. I shall proceed first with the reduction in cognitive diversity. The research performed by Hong and Page is very relevant in this sense.

According to Hong and Page, each agent that is involved in a decision-making group is endowed with a perspective and a heuristic. A perspective can be defined as 'a problem solver's representation of a problem, an encoding',[212] while a heuristic represents 'an algorithm, or rule(s) of thumb that a problem solver applies in searching for a solution.'[213]In this context, cognitive diversity does not depict the diversity of IQs or of cognitive abilities, but rather that of perspective-heuristic

[212] Lu Hong and Scott E. Page, "Problem solving by heterogeneous agents", *Journal of Economic Theory* 97 (2001): 126.
[213] L. Hong and S. E. Page, op. cit., p. 126.

pairs. Hong and Page's analysis of the decision-making capabilities of economic agents indicates that cognitive diversity trumps cognitive ability and that a cognitively diverse group will outperform the cognitively highest able group. The explanation of these results lies in the fact that a problem solver's contribution to a group's outcome is context dependent, being circumscribed to 'the relationship between his or her human capital and those of the other problem solvers.'[214]As such, collective decision-making should be perceived as a synergistic, rather than an individualistic cognitive endeavor. It is not only about personal cognitive endowments, but also about the way in which each agent's perspective and heuristic relate to those of others and, in this way, add value to the group's decision-making outcome.

Hong and Page's analysis does not solely apply to economic agents. Helene Landemore, for instance, has extended their results to the field of democratic theory as well. According to her, 'democratic reason is more a function of the cognitive diversity of the individuals taking part in the decision than of their individual ability.'[215]Although increasing the number of the individuals involved in the decision-making process is likely to naturally increase the cognitive diversity of the group, 'trying to increase the IQ of the average member of the decision-making group by picking a certain type of people is likely to reduce cognitive diversity.'[216]

With the advent of specialized cognitive enhancers, one does not only need to choose specific individuals, part of a certain cognitive category, in order to reduce the cognitive diversity of the collective. This can ultimately occur naturally if everybody ends up enhancing their cognition in a similar way. The fact that cognitive enhancements dedicated to specific areas of the brain are very likely to be developed gradually and to enter the market in a stepwise fashion means that whoever

[214] L. Hong and S. E. Page, op. cit., p. 127.
[215] Helene Landemore, "Why the many are smarter than the few and why it matters", *Journal of Public Deliberation*, 8(1) (2012): 1.
[216] H. Landemore, op. cit., p. 6.

wants to enhance their cognition or that of their children will only have to decide whether they want to enhance or not. The method of enhancement will most likely not be prone to choosing. I have to emphasize that this line of thinking applies exclusively to specialized and radical cognitive enhancers. The drugs and procedures that could be labeled at this moment as cognitive enhancers act at the level of the whole brain by stimulating cerebral blood circulation or the communication between the left and the right hemispheres. These drugs are not specialized and do not aim at improving specific cognitive functions. At the very most, they can be directed toward memory upgrading, although not in a radical way. On the other hand, the cognitive enhancers that have the potential of creating some coordination problems at the collective level are characterized by a high degree of specialization. As such, they upgrade particular areas of the brain and their associated cognitive functions.

In this context, the balance of benefits and burdens associated with cognitive enhancement is tilted in favor of the individual and at the expense of the collective. When a cognitive upgrade can be correlated with so many socio-economic advantages, it seems only natural for people to want to pursue this enhancement path. However, the decrease in cognitive diversity that accompanies it may be detrimental to optimal group decision-making. It follows that cognitive homogeneity can indeed be regarded as a collective action problem.

Now, what is the situation for those cognitive enhancements that are conducive toward human heterogeneity? Could cognitive heterogeneity count as a collective action problem? The reason for which Gyngell and Eastell perceive it as such is due to the fact that it has the potential to reduce mutual empathy at the level of the collective. It is not obvious, nonetheless, why cognitive diversity should result in diminished empathy and, consequently, why it should make us morally worse off as a group. Empathy represents the ability to share the feelings of others. This said, radical enhancement and synthetic biology might end up fostering, rather than hindering our capacity for empathy. For once, they could push the limits of our cognition to new territories and absolutely

novel traits that no other human being has known before, like, for instance, telepathy. If we stick to the example of telepathy, it goes without saying that the possibility of reading someone's mind also leads to being aware of that person's feelings. Thus, from a purely cognitive perspective, enhancements should not interfere with mutual human understanding. Fair enough, one might rightfully dismiss this whole defense of cognitive enhancement by arguing that a new sense, like telepathy, does indeed lead to a first-hand exposure to other people's emotions. Unfortunately, this should not mean that individuals will necessarily act on the knowledge they receive telepathically in a morally acceptable way. Knowing other people's emotions might lead to manipulations of all sorts that share nothing in common with what we normally see as the core of empathic behavior. Besides the pure knowledge of other individuals' emotional states, empathy also requires actions that attempt to produce an increase in the genuine well-being[217] of the person we are empathizing with. Empathy is sown with good intentions.

Although there is definitely a link between cognition and moral behavior, there is no causal relationship. Our moral behavior is shaped by the interaction of multiple factors, among which cognition is just one, alongside mood and environmental conditioning.[218] Empathy begins with cognition. However, what is important here is not a highly specialized cognitive function, but a general capability that any human being possesses and without which it is highly likely that human life could not even proceed in a normal way: perception. Thus, whether you want to be a scientist or an artist, perception is something that transcends the desire for acquiring certain skills. It is a necessary prerequisite for human life and a trait that could never be selected against through genetic enhancement. Ultimately, we use perception to eat, to walk, to cross the street, to identify dangers, the near and dear etc. To return to empathy, as a significant and illustrative type of moral behavior,

[217] By genuine well-being I understand the kind of well-being that stems from the true preferences of individuals. It is not adaptive and it is not induced by anything outside the agent's free will.
[218] Stephanie D. Preston and Frans B. M. de Waal, "Empathy: its ultimate and proximate bases", *Behavioral and Brain Sciences* 25 (2002): 1-20.

research shows that it is triggered by the 'perception of an object's state', which 'activates the subject's corresponding representations, which in turn activate somatic and autonomic responses.'[219] There is a lot of evidence that highlights mood, and not cognition, as being connected with moral behavior.[220] Given this, it would be unrealistic and unfair to hold cognitive enhancement responsible for a possible decline in empathic attitudes. If cognitive enhancement can influence moral behavior it can only do so in a positive way. So far, everything points to the conclusion that a potential cognitive heterogeneity of the human species does not constitute a collective action problem, as there is no harm brought to the collective.

That the increase in cognitive diversity does not represent a collective action problem does not exonerate the fact that its reverse, cognitive homogeneity, does. What is to be done in this case? There are three possible scenarios. First, cognitive enhancement could be outrightly prohibited on the grounds that it harms the collective. But then the following two issues emerge. If no specific individual is harmed within the generation undergoing the enhancing procedure and all individuals, irrespective of their generational background, are benefitted by improving their cognition, does it matter when an unidentifiable future group of people collectively share the burden associated with each other's personal accrual of advantages? Apart from the problem stemming from the characteristics of the agents receiving the benefits or the residual disadvantages of enhancement, there is also the question of the significance of cognitive improvement for the human species. Upgrades in human cognition could make room for new capabilities that might make life much more pleasurable and rewarding than it currently is. Thus, there is an opportunity cost of not enhancing which, unfortunately and inevitably, will have to be paid by the very same group of

[219] S. D. Preston and F. B. M. de Waal, op. cit., p. 1.
[220] Please see Molly J. Crockett et al., "Serotonin modulates behavioral reactions to unfairness", *Science* 320 (5884) (2008); Laura Steenbergen et al., "Tryptophan promotes charitable donating", *Frontiers in Psychology* 5 (2014): 1451; J. A. Barrazza et al., "Oxytocin infusion increases charitable donations regardless of monetary resources", *Hormones and Behavior* 60 (2) (2011): 148-151; M. J. Poulin et al., "The neurogenetics of nice: receptor genes for oxytocin and vasopressin interact with threat to predict prosocial behavior", *Psychological Science* 23 (5) (2012): 446-452.

people that will be collectively harmed by the homogeneity arising from the enhancement of the human cognition. This second issue discharges the need to address the first issue due to the following reason. If the opportunity cost of not enhancing is higher than the burden associated with the collective action problems, then it makes no difference what kind of agents are involved in the distribution of costs and benefits. When confronted with two harms, it is reasonable to assume that one's duty is to avoid the harm with the biggest negative impact. If we keep everything else constant, in this particular case related to cognitive enhancement and future generations, not enhancing is the most significant harm because it will lead to delayed or forsaken opportunities to increase the quality of human experiences and, as Nick Bostrom insists, to reach utopia. To make matters worse, keeping everything constant is not even possible. Failing to enhance means that those individual benefits that jointly lead to collective action problems will be out of the picture, leaving everybody, on average, worse off than otherwise. Moreover, there are not only collective harms that can stem out of individual cognitive gains, but collective benefits as well, such as progress in different technological, scientific or social areas. Also, on standard economic assumptions, future generations are going to be better off economically than the present ones. Therefore, they might legitimately bear a larger share of the burden of enhancement. It follows that, total abandonment, which is the first possible solution to the problem of cognitive homogeneity resulting out of enhancement, should be dismissed on the grounds that it disadvantages all the concerned parties.

The second scenario that could be envisaged as a way to counteract the negative effects of diminished cognitive diversity would simply be to ensure that there exists good coordination at the group level such that the collective action problem does not come into existence. The best agent that could discharge this responsibility of making sure that individuals' behavior regarding genetic decision-making is synchronized is, in the most realistic interpretation, the state or an international regulatory body. State involvement in the reproductive choices of its citizens could be regarded as an

infringement of the latter's autonomy in pursuing their conception of the good life. However, we should not disregard the fact that reproductive freedom is not absolute and that it can be rightfully limited whenever the well-being of the child is at stake. As such, there is no *prima facie* reason for which the state could not, in principle, aim to solve a problem of social coordination in this area. Now, although reproductive freedom does not constitute an insurmountable obstacle for state intervention, there is, however, another concern. In order to avoid the creation of a collective action problem, the state may decide to limit the parents' use of enhancing technologies. Thus, only *some* parents could employ *some* genetic technologies under *some* specific circumstances. An inevitable question arises in this context. What should the state's demarcation criteria be for allowing or prohibiting enhancements? As cognitive upgrades are not necessary for individuals' good state of health and its associated well-being, it is extremely difficult, if not impossible, to justify a restricted access to these technologies. Should the lucky beneficiaries of enhancements be those of a certain age, socio-economic status, family size, social merit, suffering from disabilities or past social injustices etc? There are certainly no clear grounds for differentiating between these groups and possibly others in a meaningful way that could relate to the issue at hand: the desirable but not necessary improvement of one's abilities that can be expected to correlate with personal benefits. As such, it is unfortunate that, while aiming to solve a collective action problem, state intervention in the distribution of enhancements might very easily lead to social injustice via the painful route of discrimination. The harms associated with discrimination can have such profound implications for the entire social fabric that the public regulation of parents' reproductive decisions, performed under these terms, cannot properly outbalance the harms coming from the future collective action problem. If there can be no clear principle behind the distribution of these limited genetic enhancements, one might resort to the idea of a lottery. A social lottery has the advantage of allocating, in a non-discriminatory way, indivisible scarce resources which, through their very nature,

could not be partitioned and shared in equal bundles to everybody. There are some problems, however, that this social lottery raises. The most significant one is that it elevates luck at a much higher position than it should have in a theory of justice. Usually, such theories aim at compensating the unlucky. A social lottery, on the other hand, either creates them or adds to their previous bad luck. An enhancement lottery would nullify, to a great extent, our attempt to subdue chance and to embrace choice. In the end, it would turn out to be unfair, as its outcomes may very well fail to distinguish between the participants' backgrounds, desert or severity of situations. Given all this, state intervention should be rejected.

Fortunately, there is one more path to consider while attempting to solve the collective action problem coming from the use of enhancing genetic technologies. It might just be the safest approach to acknowledge that there *is* an issue and bite the bullet. Given that a full spectrum of cognitive enhancements can only be developed if and only if one starts from somewhere, the lack of cognitive diversity accompanying this process is inevitable and, fortunately, temporary. It is merely a transition. However, even if we bite the bullet, this does not mean that we cannot do anything about it. If we cannot avoid the temporary decline in diversity, we may at least speed it up. This could be achieved by encouraging and investing in the cognitive enhancement industry. What happens when we transpose this solution on the generational grid? It is highly likely that, from a generational perspective, those individuals who invest the highest amount of effort in drafting the roadmap toward radical and specialized cognitive enhancement will end up receiving marginal benefits as compared to their descendants. At a first glance this may seem unfair. Nonetheless, it is important to emphasize that although there is an asymmetry with respect to the effort-benefit input of each generation, pursuing cognitive enhancement will overall leave everyone better off than not pursuing it. In the end, marginal benefits are better than no benefits. Also, we should bear in mind that the collective action problem is bound to increase in magnitude generation after generation. Those

finding themselves at ground zero, at the beginning of the enhancing attempts, are most surely not to be affected by it. Given all this, I argue that pursuing genetic enhancements is the optimal way to go in imagining and designing the future world of the yet unborn people and in treating the members of all generations in a fair way. There might be occasional bumps that we should deal with while developing and using these genetic technologies. One such bump is the possibility of collective action problems affecting the distant generations. However, these problems could, in principle, be surpassed and do not undermine in any way the value of the goods that are to be achieved via enhancements.

This subsection has been dedicated to exploring the pattern that collective action problems resulting out of human genetic enhancement might take. I have used very concrete examples in order to illustrate these points. Given the highly applied nature of bioethics, I believe that there is more to be induced from the particularity of its cases as opposed to relying on deductions from general principles.[221] The examples used, nonetheless, illustrate general angles and patterns. To sum up the entire discussion, I have first presented the core elements of a collective action problem in the context of genetic enhancement and future generations. Surprisingly or not, some types of human enhancements turned out to be wrongfully classified as collective problems. Also, it appears that even if some upgrading technologies have the potential of hurting the collective while benefitting the individual, the opportunity cost of not putting them to use is higher.

Many times, the field of genethics functions as a balancing discipline, identifying the trade-offs associated with genetic decision-making and pitting them against one another. This particular discussion makes no exception. I would very much like to highlight the fact that, irrespective of the long-term choices that we make, there will always be a certain potential for harm embedded within them. Thus, whenever we are exposed to the downsides of a specific vision of the future, we should

[221] Suffice to say, this does not amount to a rejection of deduction as a methodological tool for bioethics research.

not immediately dismiss it on that account. Each vision of the future will be bad in some way, at some time and for an identifiable or unidentifiable someone. This cannot and should not speak against it. Only a comparative analysis of potential future states could yield us a good enough result that could lay at the foundation of our actions.

2. Future generations, genetic enhancement and global risks

Risks are an inevitable part of everyday life. Some have minor effects, others catastrophic outcomes. Some can be foreseen on time, others leave room for no anticipation. The further one looks into the future, the more deceiving its perils and promises. It is safe to say that we cannot avoid all risks. Moreover, it might also be the case that, in our attempt to solve some risks, we may end up creating others. Let me provide an example. One of the most heated topics in relation to risk creation and avoidance is that of genetically modified crops. In their efforts to solve some expected, though incompletely defined, future risks, several countries are willing to accept the ripening of current risks. In 2002, for instance, Zambia refused to receive the genetically modified corn offered by the US as food aid, in the context in which the UN Food and Agriculture Organization estimated that 2.9 million people would be exposed to the risk of starvation.[222] One risk was traded for another and, although we engage in temporal discounting most of the time, in this case preference was given to avoiding future rather than present risks. Why should this be the case?

One way to glimpse into this problem is by employing Nick Bostrom's risk typology. According to Bostrom, there are three dimensions that can define the magnitude of a risk: scope (the size of the group exposed to the risk), intensity (the extent to which each individual in the group would be harmed) and probability (the best subjective estimate of the likelihood of occurrence of

[222] H. Sterling Burnett, "Understanding the Precautionary Principle and its Threat to Human Welfare", *Social Philosophy and Policy Foundation* (2009): 408.

the adverse outcome).[223] The scope of a risk can fall into one of the following three categories: personal, local or global. Intensity accounts for two types of risks, endurable and terminal. Endurable risks are the ones that present some potential for recovery or good mechanism for coping with their outcomes. Terminal risks, on the other hand, are associated with total annihilation and destruction. The type of risk that I am interested in discussing here is the global one, be it endurable or terminal. Terminal global risks are also known as existential risks, because ultimately they threaten the very existence and continuation of the human species. I have previously defined the concept of future generations in a very broad manner from the perspective of their geographical spread, and, as such, only global risks may constitute legitimate targets for my intergenerational concerns. Nonetheless, it should be noted that local risks also have the potential of affecting more than one generation.

Does it matter for an account of justice between generations whether the risks to which future people are exposed fall within the global endurable or existential risk category? Should one differentiate between these two types of risks that the yet unborn generations are likely to face in such a way that is reflected in the attitude and behavior of the current people? Imagine that the present generation is faced with two types of dangers that will affect the future and there is only one possible way of meeting them. Aiming at alleviating the dangers posed by both of these problems is theoretically and practically unfeasible. As such, the present generation has to make a choice, a choice which will be both inclusive as well as exclusive. It will include a solution to one type of risks, while it will exclude any attempt to touch the other. Imagine also that the dangers threatening the future are the following. On the one hand, suppose that unconstrained global warming will lead to the complete melting of the polar ice caps in approximately 200 years. [224] On the other hand and

[223] Nick Bostrom, "Existential Risks: Analyzing Human Extinction Scenarios and Related Hazards", *Journal of Evolution and Technology* 9 (2002).
[224] The estimation is purely hypothetical for the sole purpose of fitting the thought experiment.

1,000 years from now, an asteroid impact could kill all life on earth. The present generation needs to decide on which problem is going to attempt to solve, given its available resources. The melting of the ice caps will occur first. However, the asteroid collision will affect the very existence of the human species. Which of these two concerns should trump: temporal proximity or dealing with the worst case scenario?

Failing to secure the possibility for human reproduction and, thus, contributing to the extinction of the human species amounts to harming the countless number of probable future generations that might had come into existence were it not for their predecessors' lack of skillful risk management. From this perspective, the reasonable thing to do is to give priority to the most distant problem on the ground that it has unparalleled and extremely harmful consequences for human life. One question emerges, in this context. Let's say that the average life expectancy is 70 years of age and is bound to increase by 2 to 3 years each generation. 1,000 years would amount to 13 or 14 generations. Now, why would the generation that discovers the far-off risk should also be bound to solve it or initiate the first attempts in this direction if there are more than 10 generations in between that could also perform the task? Moreover, why should this first generation have a duty toward the very distant future when the more proximate future will be experiencing problems as well? If it had not been for these two conflicting needs over the present generation's resource allocation, there would be no problem to begin with. Most of the time, however, these sets of different demands do exist in real life cases and they raise the very important question of intergenerational allegiance.

The issue of intergenerational allegiance can also take another form. Suppose that the current generation is able to produce through the advent of radical cognitive enhancement a technology that will undoubtedly benefit the next four generations, but which in time will become riskier and riskier. Artificial intelligence can plausibly be considered one such technology. I will refer

again to Nick Bostrom's work,[225] whose interest and research into existential risks have led him to pinpoint artificial intelligence as a source of concern for its destructive potential with respect to the entire human species. It is undeniable that an intelligent machine might come in handy in a wide variety of areas and that it could help us find the answers to many of the problems that humanity is facing or is going to face at one point in the future. Nonetheless, it is very likely that superintelligence will be laden with risk and, more specifically, with existential risk, in its search for optimization. The paperclip argument is most illustrative in this sense:

> A superintelligence whose top goal is the manufacturing of paperclips, with the consequence that it starts transforming first all of earth and then increasing portions of space into paperclip manufacturing facilities.[226]

Thus, one does not need to conceive of superintelligence in terms of it being friendly or unfriendly in order to talk about existential risk. The potential for danger is embedded in the very basic characteristic of an intelligent machine, which is that of optimization. Too good of an optimization process correlated with ignorance regarding the values that humans hold dear might indeed solve one problem, but will create bigger ones in its stead. One could imagine a scenario in which an AI with a weak optimization process or in the very first stages of development might benefit humans for several generations, only to become a liability as it gets more complex. Thus, the question that interests us here is whether the present generation should invest resources and effort into enterprises that may prove very helpful for the more proximate generations, but which, on the long run, may pose serious risks to all the generations to come.

Based on the previous two situations, it seems reasonable to conclude that what intergenerational allegiance requires is a consistent attitude toward risk that could also take into account the time sensitivity that permeates any theory of justice between generations. It would be

[225] Nick Bostrom, *Superintelligence: Paths, Dangers, Strategies* (Oxford: Oxford University Press, 2014).
[226] Nick Bostrom, *Ethical Issues in Advanced Artificial Intelligence,* available online: www.nickbostrom.com Last accessed: May 2015.

equally useful and desirable if we could provide a principled way of making such decisions. However, there are so many variables at play as far as these difficult choices are concerned that any attempt to construct decision-making algorithms that involve the future runs the risk of becoming Sisyphean in nature.

Although the examples I have presented seem to be quite implausible at the moment, we have, nonetheless, met these very specific patterns throughout our history. Think about our decision to exploit the planet's natural resources or about the production and widespread use of antibiotics. What sets real life apart from my thought experiments is one crucial element that complicates our moral reasoning: knowledge. Thus, when the first antibiotic was used, we did not know anything about its consequences for the distant future. If it accomplished the task that it had been designed for, then it could, by all means, count as a success. Ripple effects were of no great significance, given the demands of the present, its scientific state of the art and the uncertainty surrounding the future. But now we know more. We know that our actions, decisions and technologies may have unintended and unanticipated effects which could materialize within the lifespan of many generations to come.

One could answer to the question of intergenerational allegiance by looking at the world as it is right now and, with that information in mind, travel back to the time when decisions with important negative ripple effects – such as antibiotic use or natural resource exploitation – were made. Given all that we know about the way in which the world will turn out, we should decide on whether we would rather avoid those risks that are bound to occur in the future, or embrace the benefits brought by these products and technologies.

Risk aversion amounts to changing the whole trajectory of the world's development. As such, not only certain perils will be avoided, but also many benefits that could have been incurred into the future. Furthermore, risk aversion accompanied by the refusal to use possibly dangerous

technologies could create risks of their own, notwithstanding existential risks. On the one hand, the problem that the possibly dangerous technology was meant to solve could lead to disastrous consequences if left untackled. Imagine a pandemic's outcome in the absence of antibiotic treatment. It might have dire consequences for the whole human species. On the other hand, technological development and the improvement of the present generation's standard of living can create an environment that is conducive toward even greater technological development and which could give future generations a jump-start into the way in which *they* approach their own problems. Basically, not being too risk averse and choosing to employ technologies that might harm the distant future could very probably help the very same people that they threaten by contributing to the creation of a trajectory that will be beneficial, in the long run. Humanity, as a whole, does not only face man-made perils, but also a wide range of dangers that lay outside of its control. A good trajectory for the human species could successfully deal with all of these problems, as they appear. Delaying technological development on the ground that it is dangerous would only leave us exposed to other dangers. Human evolution is a great history of trial and error. We keep on moving forward by facing our immediate challenges, while the solutions to these challenges keep on building up and on jointly improving the lives of the yet unborn people. Afterwards, we search and eventually find a way to counteract the negative effects of our previous solutions.

To sum up, risk aversion and the protection of the future from man-made dangers suffer from one major theoretical flaw, namely, the assumption that everything else remains constant and that there will be no other threats, unrelated to human activity, to worry about. Similarly and as far as our duties toward closer or more distant future generations are concerned, being risk averse and employing resources in such a way that priority would be given to existential risks may turn out to be a self-defeating strategy. For once, it is impossible to predict how the entire world will evolve a great many years from now and how this evolution will impact the existential risk(s). Second, the safest

approach and, ironically, the most risk averse when confronted with the uncertainties of the future, is that of ensuring the steady development of the most proximate generations so that a good trajectory can be maintained for all generations to come. There might be solutions to very remote existential risks that we cannot even begin to imagine in the present moment, but which could be envisaged by the humans living 100 or 200 years from now. The idea of the general trajectory becomes even more appealing, given the fact that technological growth occurs at an exponential rate.[227]

One could argue that my defense of our allegiance to the closer and less risky future, as compared to the more distant and more dangerous future falls victim to the theoretical pitfall opened by the anthropic bias. The anthropic bias amounts to poor reasoning due to observation selection effects. An observation selection effect exists when the property of the thing that we observe is correlated with the fact that the observer exists in the first place.[228] Thus, our very existence means that no dangerous technology has wiped our species out. Relying on history in this case is biased because we are here to begin with. Although my previous argument might reasonably be considered biased on these grounds, in its essence, it is not. I do not claim that the way in which our history has unraveled until now should perfectly overlap with the way in which it will unfold in the future. What I propose and what I want to emphasize here is the desirability of a good trajectory, given that we might not even know right now what the best approach for solving an existential risk would be. Doing otherwise would be prone to biases of its own, such as the base rate fallacy, which highlights the error of focusing on specific information to the detriment of general information[229] (existential risk v. general trajectory); anchoring, which could be viewed as the tendency to rely too

[227] According to Moore's Law, the number of transistors on a chip will double every 18 months to 2 years. Please see Gordon E. Moore, "Cramming more components onto integrated circuits", *Electronics Magazine*, 19 (1965): 114-117.
[228] Nick Bostrom, *Anthropic Bias: Observation Selection Effects in Science and Philosophy* (New York and London: Routledge, 2002).
[229] Jonathan Baron, *Thinking and Deciding*, 2nd ed (Cambridge: Cambridge University Press, 1994): 224-228.

much on a certain aspect of one's decision-making process[230] (in this case, the existential risk); or the distinction bias,[231] which compels one to view two options less similar when evaluated at the same time, as opposed to when they are assessed separately. Ultimately and in connection to the third bias, what I argue is that the distant future can be better helped if the demands of the more proximate future are properly taken into account. In this way, we control for the unknown and for the unpredictable.

Several moral theories have attempted to provide an answer to the issue of social risk and risk imposition. Consequentialism, for once, is centered on the idea that the evaluation of an action is determined by its outcome. To a large extent, consequentialist thinking abides by a risk-benefit analysis, which takes into account the probability and the utility or expected utility of competing outcomes. Consequentialism proceeds by interpersonal aggregation, focusing on the overall goodness of an action, irrespective of the way in which each individual is being treated.[232] On general grounds, consequentialism could be rejected as a valid moral theory of social risks due to its incapacity to account for the separateness of persons. When applied to the question of intergenerational allegiance, consequentialism and its failure to relate to individual well-being would systematically lead to the repugnant conclusion. As such, the utility associated with the unidentifiable number of future generations that would exist if existential risks were solved would always weigh against the utility of the more proximate generations solely due to the high – and potentially infinite – number of the former.

If consequentialism does not represent an optimal framework for discussing social risks, there are several other non-consequentialist and non-aggregative approaches that one could

[230]Yu Zhang, Mark Lewis, Michael Pellon and Phillip Coleman, "A Preliminary Research on Modeling Cognitive Agents for Social Environments in Multi-Agent Systems", *AAAI 2007 Fall Symposium, Emergent Agents and Socialites: Social and Organizational Aspects of Intelligence* (2007): 1116-123.
[231] Christopher K. Hsee, Jian Zhang, "Distinction bias: Misprediction and mischoice due to joint evaluation", *Journal of Personality and Social Psychology* 86 (5) (2004): 680-695.
[232] Madeleine Hayenhjelm and Jonathan Wolff, "The Moral Problem of Risk Impositions: A Survey of the Literature", *European Journal of Philosophy* 20 (2012): 26-51.

embrace. For instance, deontology emphasizes a rights-based perspective that extends the duty not to harm other people to the duty of not performing actions that increase their risk of being harmed.[233] Unfortunately, the rights-based theory is prone to the problem of paralysis,[234] which would lead to refraining from all action on account of being risky. Alternatively, consent could represent a better starting point for a discussion about risk and risk imposition. As this view goes, a risk becomes permissible if one consents to it. However, this account is not as straightforward as it seems at a first glance. Judith Jarvis Thomson's 'The Unpleasant Way' illustrates its shortcomings very well:

> Suppose there are two ways in which I can get home from the station at the end of the day. The first is pleasant, passes through a brightly lit middle-class shopping area, is quite safe, but is long. The second way is unpleasant, passes through an ill-lit area of warehouses, is unsafe, but is short. Nobody has ever been mugged while walking along Pleasant Way; people have from time to time been mugged on Unpleasant Way. Here I am at the station; I'm tired; I think 'The Hell, I'll chance it, I'll take Unpleasant Way.' I then promptly get mugged.[235]

What Thomson's puzzle shows is that one is still wronged even if one is aware of the risk of being wronged. Consenting to a risk does not equal to consenting to the burden of that risk. In the interpretation of Hayenhjelm and Wolff, '[t]he fact that she consented to walk down Unpleasant Way, and knew that a mugging was a practical possibility, is not enough to make it the case that she has consented to the mugging.'[236]

Another way of looking at the problem of social risks is through the lenses of contractualism. According to Scanlonian contractualism,

> [a]n act is wrong if its performance under the circumstances would be disallowed by any set of principles for the general regulation of behavior that no one could reasonably reject as a basis for informed, unforced, general agreement.[237]

[233] Sven Ove Hansson, "Risk", *The Stanford Encyclopedia of Philosophy* (Spring 2014 Edition), Edward N. Zalta (ed.), URL = <http://plato.stanford.edu/archives/spr2014/entries/risk/>.
[234] Sven Ove Hansson, "Ethical Criteria for Risk Acceptance", *Erkenntnis* 59 (2003): 291- 309.
[235] Judith Jarvis Thomson, *Rights, Restitution, & Risk: Essays in Moral Theory* (Cambridge, MA & London, England: Harvard University Press, 1986): 139
[236] M. Hayenhjelm and J. Wolff, op. cit., p. 45.
[237] T.M. Scanlon, *What We Owe to Each Other* (Cambridge, MA: Harvard University Press, 1998): 153.

Basically, that action or principle that is justifiable to each person can be considered morally right. This perspective avoids the issues of interpersonal aggregation, paralysis and consent to risk through its reasonableness constraint and focus on individual well-being. In the context of intergenerational allegiance, Scanlonian contractualism would support the idea of a good developmental trajectory on the grounds that it is a principle that could not be reasonably rejected by any individual out of personal reasons.

To sum up this section, genetic enhancement could enable future generations to find themselves on a good developmental trajectory so that they successfully meet the challenges posed by global and existential risks. Enhancements alone will not eliminate humanity's problems. But constantly upgrading human capacities, be them cognitive, moral of physical, will allow individuals and their communities to flourish in unprecedented ways. Enhancement is not an easy fix, but rather part of a steady process that keeps on evolving from good to better. Is genetic enhancement a necessary part of this process? Yes. Some of the existential risks of the future might catch humanity unprepared. Genetic enhancement is one feasible way of greatly diminishing the chances of this happening.

3. Future generations, genetic enhancement and utopic singularity

For hundreds of years, humanity or, to be fair, some part of it, has dreamt about utopia. The exact outlines of utopia may vary considerably, but there is one thing on which most utopian literature that was written before the flourishing of genetics agrees. Utopia lies somewhere outside of us, it is a feature of our external environment, an idealized construction of our social fabric. *The City of the Sun* or Moore's *Utopia*, which have enticed the imagination of numerous generations of readers, are written along these general lines. Religion and mythology can also count as sources of utopian and dystopian thinking alike. Ultimately, afterlife rewards and sanctions constitute the extremes of

the human imaginary potential for pleasure and pain. Still, they remain confined to the outside world and to our relationship with it.

The possibility of altering ourselves and our descendants has changed the way in which we have come to perceive utopia. Thus, utopia does not only relate now to the world in which we live, but it is also reflected into the kind of persons that we could become. Physical enhancement could transform our bodies in such a way as to eliminate many of the common stressors of our everyday life, like fatigue or hunger. Moral enhancement could expose us to a wide array of feelings and emotions, which could enrich us in countless ways. Improved or newly added cognitive capacities may bring about intellectual pleasures that we are not even able to fully anticipate at the moment. If this sounds too good to be true, remember that it is utopia that we are talking about here.

In principle, genetic enhancement can lead to an elevated state of well-being for both present and future generations through its direct and indirect effects. One might argue, however, that genetic enhancement could also create fake paradises, Brave New Worlds and Nozickean experience machines. Thus, rather than providing bliss, it might just give us the illusion of it. The problem with this view is that fake utopia is not utopia. There are many paths that could help us attain a fake utopia: narcotics, alcohol, antidepressants. But there are much fewer options for striving toward the genuine one. Genetic enhancement, through its deep and long reach, is most likely our safest bet in this direction.

CHAPTER 6

Future Generations, Genetic Enhancement and Distributive Justice

The more there is of mine,
the less there is of yours.
(L. Carroll)

In the previous chapter I set the ground for discussing the way in which genetic enhancement may influence the lives of the generations to come. Also, I started to address there some of the concerns that could be raised in relation to the intergenerational aspects of the intragenerational distribution of enhancing procedures. In this part of the thesis, I will finalize this discussion by focusing on an aspect which, through its depth and centrality with respect to the main question of my dissertation, deserves a chapter of its own. I am referring to the issue of distributive justice. Thus, my aim here is to explore whether genetic enhancements may shape the outlook of future societies in a manner that is compliant with the requirements of social justice.

Genetics represents one of the strongest bonds that links past, present and future generations. Undoubtedly, much of who we are and of what we can accomplish can be traced back to our genetic composition. Not only our skills or personality traits can be accounted for by genetics, but also our capacity for happiness. In this way, our genes determine, to a certain extent, our levels of personal and social satisfaction and the distribution of other types of non-natural resources, like professional occupation, income, social status or social bargaining power. These facts have been evident for political theorists for quite some time already. As a consequence, there is a large body of

literature focused on justice and natural inequalities which tackles the importance of our natural assets for the purposes of social justice. In this sense, luck egalitarianism aims at designing ways for coping with those inequalities that arise out of situations that are beyond our control and which could be placed within the sphere of differential luck. Such as, for instance, our genes. Rawls also emphasizes the moral arbitrariness of the genetic lottery that affects us all and its implications for distributive justice:

> The existing distribution of income and wealth, say, is the cumulative effect of prior distributions of natural assets—that is, natural talents and abilities—as these have been developed or left unrealized, and their use favored or disfavored over time by social circumstances and such chance contingencies as accident and good fortune. Intuitively, the most obvious injustice of the system of natural liberty is that it permits distributive shares to be improperly influenced by these factors so arbitrary from a moral point of view.[238]

Hence, until recently, genetics was perceived as nature's arbitrary gift and something that should be neutralized or compensated, though not directly distributed, in a theory of justice. The unraveling of the human genome, together with other advances in molecular biology, computation and genetic engineering made possible the reconceptualization of genetics, as an element of social justice, and allowed it to be placed at the very center of the distributive process. Our ability to know our genetic make-up, accompanied by the potential to act upon that knowledge, paved the way toward a process of incorporating natural resources into the larger bundle of social resources that are to be allocated according to the precepts of distributive justice. Basically, we have now a new channel for addressing injustice which is focused on the distribution of the genes themselves and not solely on neutralizing their bad effects.

The central position that our genetic endowment occupies in any theory of distributive justice gives birth to some very significant questions which, through their scope, apply to both

[238] John Rawls, *A Theory of Justice* (Cambridge: Harvard University Press, 1971): 72.

present as well as to future generations. It is quite difficult, if not impossible, to have a meaningful discussion about justice and genetics in the absence of their intergenerational and intragenerational components. There are three reasons for this. First, genes and even epigenetic mechanisms are heritable from one generation to another. Second, many of the genetic decisions that we will be faced with will not necessarily or exclusively involve ourselves, but also our offspring. Third, genetic modifications will greatly influence the social configuration of the current generation's community and of those to come by creating a specific path of wealth and role allocation. Thus, in this area perhaps more than in others, the decisions and actions of the present will have a huge impact on the future.

I explore two main issues in this chapter: the *micro-allocation* and the *macro-allocation* aspects of the distribution of genetic enhancements. The first raises the following concerns. Should genetic enhancements be made available to everyone? If yes, on which grounds and according to which pattern? If not, why not? The issue of macro-allocation follows three principal routes. First, given resource scarcity, should all enhancements be ranked equal in terms of their added value and be given the same weight for distributive purposes? For example, should cosmetic enhancement be on the same par with cognitive enhancement as far as the allocation process is concerned? Second, there is the question of the investment in genetic therapies as compared to the investment in the environment. Thus, which proportion of our resources should be oriented toward the medical sector and which to other non-health related fields that contribute, in conjunction with medical procedures or even independently, to bringing about a desired phenotypic trait? Finally, the epigenetic switches that enable or hinder the expression of genes are heritable along generational lines and are closely related to one's ancestors' lifestyles. In this context, it is worth investigating to what extent such a personal and intimate part of us, namely, all the little habits that we eventually call a lifestyle, could represent one of the objects of a theory of justice.

1. The micro-allocation problem

The question of micro-allocation is concerned with two main aspects of the distribution of genetic enhancements: the identity of the recipient of the enhancement(s) and the pattern of distribution at the social level.

As you might remember from a previous chapter, I define enhancement as a medical procedure that is not necessary for a healthy, good life. According to my understanding, enhancements travel beyond good. However, there are some circumstances in which enhancements prove to be crucial for the attainment of our goals. I am referring here to the realization of our conception of the good life. The way in which we construct the ideal life that we would like to live can, many times, come to embed a certain element of wishful thinking that could not be successfully traced back to the reality surrounding our external environment or our persons. We may dream of completing projects for which we are not or could never be physically fit. We may have an image of our ideal selves and yearning for self-improvement that could only be reached if we went beyond the upper limits of our natural abilities. We may desire intellectual pleasures that we have never experienced but of whose existence we have little doubt. Up until now, we had no choice other than adjusting our preferences and trimming our conception of the good life whenever, as much as we tried, we simply weren't fast, focused, creative, intelligent or empathetic enough in order to materialize our high-end goals.

The possibility of enhancing ourselves changes all this by enabling us to be the kind of persons that we want to be. According to some opinions, nonetheless, enhancements might very well not change anything and, furthermore, they might even make matters worse. Thus, the fact that the improvement of our personal abilities and characteristics is readily available and only an informed consent away may run the danger of making us shallow and possibly oblivious to our true nature, values and needs. We may end up acting on caprices and highly volatile moods. We may

forego what we want most for what we want now. We may give in to peer or social pressure, to nudges of all sorts and enhance in ways in which we will not take the realization of our conception of the good life further, either because those enhancements are completely independent from it or only loosely related. Granted, this is a real possibility. But it does not mean, by any chance, that the goal of living our desired life will be defeated. At most, it will be slowed down. Curiously, enhancing on a whim might end up casting more light onto what are our preferences really are because, together with the enhancement, there comes the realization whether one is satisfied or not with the current state of affairs. If no or very little satisfaction is reached from enhancing, then that will constitute sufficient ground for further inquiry into what could be done in order to lead a good life.

Fair enough, one might say, but what if the enhancement that was whimsically pursued has altered you so much that you cannot identify anymore what your real values and preferences were prior to it? Suppose that your dream was to be a poet and that your entire emotional make-up seemed to be perfectly cut for the role. You could easily identify and relate to most emotional states. In fact, you were often swinging in between them. You could write about them coherently, but not quite as you wished, always thinking that your poor memory - though within the normal human range - impacted the quality of your choice of words and that your episodes of sadness - which never fully developed into depression - prevented you from keeping a disciplined and productive work regimen. As such, you decide to opt for enhancement. Memory and mood enhancement, to be more specific. The two procedures attain their goals. Your vocabulary has dramatically improved, as well as the speed with which you can access it. You are perfectly content all the time and nothing seems to be altering your mood anymore. Now you have all the tools for writing, but you come to realize that you have nothing to write about and that is perfectly fine. Because you don't have a desire to write poems. Moreover, you cannot imagine why you would have such a desire, to begin with.

There is something deeply bothering about this scenario and I think most of us would agree that its root lies in the rapid shift of one's fundamental views, accompanied by the fact that the second state, the post-enhancement one, seems to build the foundation for a new life, greatly alienated from what one previously cared about. The two aforementioned enhancements kill the desire to do the thing that one enhanced oneself for in the first place, and, in this way, they can be regarded as the means through which one person is replaced by another. After all, we are, to a great extent, our beliefs, values and preferences. There is, however, yet another source of disquietude in this thought experiment, namely, that we cannot reasonably perceive the pre-enhancement period, the one when writing poetry was one's biggest goal, as objectively or subjectively bad. Maybe the poems that one wrote weren't as good as one hoped for, but they were, at least, good enough and valuable. As such, not only that the enhancements failed to achieve their stated goals (namely, to write better poems) and to preserve some of the most intimate aspects of the individual's personality, but they also destroyed something that was worth keeping, which is the initial ability of writing good poetry.

The purpose of this thought experiment is to see whether genetic enhancements could, indeed, further the realization of one's conception of the good life. We can identify so far three problems in that regard:

1. Enhancements might have unintended and undesired consequences. If our poet had to choose between writing good poems and better poems, she would definitely choose better poems. But if she had to choose between writing good poems and no poems at all, chances are that she would opt for the former.
2. Enhancements may greatly affect one's core values, preferences and life views.
3. Enhancements may destroy things of value and worth keeping. In some cases, nothing of a comparable kind could be offered in return.

Given all these concerns, is it still reasonable to argue that genetic enhancements contribute to the materialization of one's desired life? I believe the thought experiment does indeed pose some serious problems to this idea, but none of them are insurmountable. The unintended and undesired consequences of enhancements could be quite successfully dealt with if together with the enhancing procedure, individuals were also offered genetic counselling. Genetic counselling sessions would serve as a good opportunity for discussing the patients' reasons for genetic enhancement and their expectations, and also for informing them about the whole range of changes that they might experience afterwards. The constant increase in medical knowledge and the data collected from previous enhancing procedures of the same type will be able to address the issue of post-enhancing transformations. Patients could be presented with informative leaflets and brochures, together with personal consultations with a professional. If the fear of unintended and undesired changes is too big, one could even write an advance directive before the procedure, stipulating the desire to have the enhancement reversed whenever some specific conditions meet.

The second problem raised by the thought experiment is the fact that enhancements may greatly alter one's personality. Now, this concern is not even a real concern, if we look at it in more general terms, because the whole point of genetic enhancement *is* to alter certain parts of ourselves. In the context of the thought experiment, however, the change in personality seems to be more disturbing than under its general formulation due to the fact that the part that has been altered could reasonably be considered of value and it has not been an intended change. And here is where problem two meets problems one and three. Thus, I argue that the second issue emerging from the thought experiment has any bearing insofar as it is linked to the first and third one: not only was one's personality altered after the enhancement, but something worth keeping has been unintendedly lost as well. If, for instance, someone wanted to increase focus and attention span, and everything went as planned and as desired during and after the enhancing procedure, the patient

then could claim that she has lost a part of her personality, which is her inability to work productively. But being able to sustain a productive work routine was part of her conception of the good life before the enhancing procedure and continues to be so afterwards as well. As such, this particular enhancement can be considered successful on all accounts.

Getting back to our initial experiment, I still have to address problem number three independent of problems two and one. A good approach toward it is to begin by looking at the characteristics of enhancements. As enhancements proceed from good/normal to better, we could expect to find many situations similar to the poet's case, in which the enhancing procedure ends up destroying something of value, something good. In a way, this outcome is inevitable and is solely due to the fact that the qualitative starting point of the enhancement is so high.

It appears that, insofar as all precautions are duly taken, genetic enhancements contribute overall to the realization of one's conception of the good life. Now that this point has been settled, let us move forward by looking at the issue of the recipients of the enhancing procedures. Who should be enhanced and on which grounds? Because we are all sentient human beings, of equal dignity and deserving equal moral concern, we should all have the opportunity to live the life that we envisaged for ourselves and for our children. Given that genetic enhancements further this aim, all members within a society should be on the receiving end of their distribution.

I propose as an allocation pattern for genetic enhancements the universal voucher system. Every member of the society would be entitled to a fixed and periodic sum of money that would cover the procurement of their desired genetic enhancements within a certain period of time. Let's say, 10 to 15 years. Similarly to Emanuel and Fuchs's proposal for a universal health voucher,[239] the funding would come from an earmarked value-added tax, which would create a direct connection between benefit levels and tax levels. If people want more funding accessible through the voucher,

[239] Ezekiel J. Emanuel and Victor R. Fuchs, "Health Care Vouchers – A Proposal for Universal Coverage", *The New England Journal of Medicine* 352 (12) (2005): 1255-1260.

they must be willing to support a tax increase. Out of autonomy concerns, there is an option for opting out of the voucher system if genetic enhancement is not compatible with one's idea of a good life. For similar reasons, this pattern of distribution would not repress the possibility of purchasing additional enhancing services with one's own resources. The voucher would constitute a guarantee of the fact that everyone will have a fair opportunity to pursue genetic enhancements and to lead a good life. Through its periodicity, it would ensure that individuals have the chance to take even further their life-time plans or to revise their previous decisions. This model is, in its essence, of a sufficientarian nature.

While developing the distributive pattern of genetic enhancement, the methodology that I followed was that of looking at the characteristics and demands of the field to which the pattern was to be applied rather than search for the optimal distributive pattern, at a more general level, and then translate it to its field of application. As such, although I endorse sufficientarianism in the allocation of enhancements, this thesis does not embrace sufficientarianism as an overarching doctrine. This said, the main reason for which the sufficientarian approach is best suited for this area is that, after being compared with egalitarian and prioritarian models, it offered greater prospects for fairness and feasibility. To be more specific, an egalitarian distribution of enhancements is unrealistic because the whole purpose of this distribution is not the allocation of the enhancements themselves, but the materialization of one's conception of the good life. This very important aspect of the distributive process points to the fact that what we would like to equalize, in fact, is not the number or quality of enhancements to which one is entitled, but rather the undividable good of one's desired life. Thus, we are not referring to the equalization of resources, but to the equalization of welfare. There are many objections to the idea of equality of welfare, in general, and many of them are particularly stringent for the issue at hand. For instance, it is extremely hard to quantify welfare given its very subjective nature and, as such, no objective data could guide the distributive process. Further,

expensive tastes could pose a great problem in the sense that they would render the allocation of enhancements unfair and possibly unsustainable. Unfair because some individuals would require much fewer enhancements than others in order to attain their life goals. Unsustainable due to the fact that those with the expensive taste might need more resources than the system could reasonably afford.

Now, what is the problem with prioritarianism? As far as enhancements are concerned and probably more than in any other field, it is very hard to identify the worse off. In order to do that, one would have to assess the quality of all the conjoined aspects of individuals' lives. This assessment would rely on both subjective, as well as objective inputs. We would have to face impossible tradeoffs that might create confusion and unfair social practices. For instance, which of these situations could reasonably be considered worse? Spending ten years in poverty while enjoying a perfect state of health or suffering from sudden adult blindness for the rest of one's life? How would any of these weigh against experiencing child abuse or living with treatment-resistant depression that makes life not worth living? Which of these situations is really worse off? Clearly, there is no definitive answer and, as such, prioritarianism fails as a framework for guiding the process of the distribution of genetic enhancements.

Sufficientarianism is more malleable to the constraints of this task, in the sense that it allows everyone to have a *fair* opportunity to live one's desired life. It is a fair approach because, for starters, no society member could reasonably feel disadvantaged as compared to others. Everybody would receive the same amount of financial resources that would ensure a *good enough* start in the attempt to reach one's life goal. One might rightfully wonder why this distributive pattern is not referred to as resource egalitarianism, as it aims at allocating equal resource bundles. The main reason for this is the correlative nature of the underlying concepts of sufficientarianism. As I was previously mentioning in this section, the aim of the distribution of enhancements is welfare. In this

sense and unlike resource egalitarianism, sufficientarianism creates an indestructible link between resource distribution and the realization of one's conception of the good life. In principle, sufficientarianism states that resources are sufficient or not *in relation to* a well-defined aim, which means that we could never assess resources independently from their ultimate goal. This characteristic is not as pungent for resource egalitarianism. On practical terms, the correlation between resources and goals will lead to constant policy assessments of the adequacy of the resource bundle that is to be allocated. Second, sufficientarianism is a fair approach also because it is intellectually honest and does not promise to deliver more than it can in fact deliver, which is a good enough start in the pursuit of one's desired life.

As appealing as the voucher system may seem, there are two important questions that stem from its application to the distribution of genetic enhancements:

1. Will children, fetuses and embryos be among the recipients of the voucher?
2. The voucher system does not exclude the possibility of purchasing extra enhancements with one's private funds. Wouldn't this option promote the deepening of social inequalities and an unjust social configuration, in which the haves may afford to pay for as many enhancing procedures as they wish, while the have-nots cannot?

Question one touches upon two distinct, although, inter-related issues. On the one hand, should children, who are devoid of legal capacity, receive vouchers for genetic enhancements? On the other, should the yet unborn people have a claim of an equal share of resources for enhancement purposes? Both issues are, in essence, of a legal nature: the first is concerned with legal capacity, while the second is interested in the legal status of an unborn person. These two aspects are extremely relevant for our discussion, given that many of the genetic enhancements that we can

conceive of right now have better prospects for success or can only succeed if they are performed before birth.

Whether unborn children count as persons or not, from a legal point of view, is far from being a new topic for debate. The question has been raised during many American court cases, up to the point that there is unanimity now that the yet unborn count as persons under criminal, tort and property law.[240] The specificity of genetic enhancements requires that they should count as persons for the distribution of enhancing procedures as well. For similar reasons, children should also benefit from enhancement vouchers. On moral grounds, it is not the realization of the child's or future child's conception of the good life that is relevant here, but the need for them to have a reasonably good start in life. Reasonably good is a highly flexible concept in this context and is attuned to the range of technological opportunities that one could access at a specific time and to the prevailing social attitudes that surround them.

Now, given that none of these two types of persons have legal capacity, it is the parents' or guardians' task to act as their surrogate decision-makers. Parents' choices might reflect the parents' own life views more than they would foster the child's well-being. There is even the danger that, in their attempt to optimize their offspring's genes, parents will embrace potentially dangerous procedures that might make their children's life less enjoyable than otherwise. The designer baby problem, which could be described as the worry that parents will superimpose their own values and preferences while choosing the genetic make-up of their children, has already been discussed in a previous chapter. There are three points to be taken from there: (1) hyper-parenting is a trend that does not manifest only in relation to genetic enhancement, (2) even without genetic enhancement, parents already influence their children's genes, and (3) human beings are not the unmediated products of their genes. Now that this issue has been settled, there is still the concern that parents

[240] G. J. Roden, "Unborn children as constitutional persons", *Issues in Law and Medicine* 25 (3) (2010): 185-272.

would choose risky enhancements that would jeopardize the child's health or general well-being. This concern is not theoretically sound because it is contradicted by the very definition of enhancement used in this thesis. Enhancement is a procedure that goes beyond good, but it does not fall into bad or undesirable. Of course, there will be enhancements that will be accompanied by side-effects. Improved hearing may lead to poor concentration. Enhanced memory may be correlated with an increased difficulty in letting go of traumatic experiences. In spite of these and other plausible examples, one may reasonably argue that the overall balance of costs and benefits will weigh in favor of the positive effects of genetic enhancements. Given that there is no obligation to enhance and also no obligation to enhance in a certain way, individuals that have traumatic memories are very unlikely to opt for memory enhancement. If let's say, parents have chosen to enhance their child's hearing, then the child will not be unable to concentrate, given that she has experienced an enhanced sense of hearing since birth and it is very much used to it. Performing enhancements before birth will minimize many of the side-effects that someone enhancing as an adult might experience.

The second question raised by the proposal of a universal voucher system for enhancements is related to its potential for disrupting social justice and equality when individuals are offered the option to incur the costs for extra enhancements. An idea that was presented in a previous chapter and which is very relevant in this context as well is that many enhancements do not only bring advantages to the enhanced individual alone, but also to her community. Moral enhancement would nicely fit the category, alongside most cognitive enhancements and even some types of physical enhancements. Also, an increased consumption of enhancements will result in greater availability and social permeation of these technologies, so that more and more people will be able to afford them. In the end, refusing to allow the purchase of extra enhancements may undermine individual liberty and autonomy and could be felt, at the level of the society, as a very repressive measure.

One might object to this line of thinking by appealing to the stark contrast that is likely to exist between the pre-enhancement and the post-enhancement worlds. The post-enhancement world might be so different from how it is right now, at the time when I am making these inferences, that the arguments that I exposed in the previous paragraph might not even be accurate at all. The enhanced human being might very well end up becoming, at one point, the post-human, having little in common with his or her human fellows. Social attitudes would shift from a general commitment to the values of dignity and moral equality, as rooted in the human nature, to a certain separation between the more abled and the less abled, which may even follow the separation between the haves and the have-nots. According to some views, we are heading toward an era of abundance.[241] We are steadily progressing toward post-scarcity. However, eliminating economic scarcity and, thus, economic inequality will not lead to an undivided society if enhancements are not managed with great care. In the post-enhancement era, personal abilities might end up mattering more for one's social status than economic resources ever did. While those that were socio-economically worse-off could still be considered worthy of respect and consideration in virtue of their human dignity, the appearance of a new type of human being might create greater discrepancies and dividing lines.

This objection could be answered in the following way. It is within the pattern of human evolution to favor change and dynamic models over static ones. The constant shifts that occur within the characteristics of the human species are an integrant part of nature and they are also emulated in the evolution of each individual human being, while she passes from childhood into adulthood and then old age. As long as the human species exists, it continues to modify itself and to evolve, very closely resembling the pattern of Hegelian dialectics which was beautifully reconstructed by G.A. Cohen in this next paragraph. The following quote depicts the evolution of the human

[241] Peter H. Diamandis and Steven Kotler, *Abundance: The Future Is Better Than You Think* (Free Press, 2014).

species, as one of the many existing living things, and its transition from one stage to the next more accurately and persuasively than I could ever do:

> This dialectical idea is that every living thing, every functioning thing, every live thing, including not only the literally living things studied by biology but also live systems of ideas or trends in art or smoothly functioning societies or vigorous families—every such thing develops by unfolding its inner nature in outward forms and, when it has fully elaborated that nature, it dies, disappears, is transformed into a successor form precisely because it has succeeded in elaborating itself fully. So the dialectical idea is the idea of self-destruction through self-fulfillment, of self-fulfillment in a self-destruction which generates a new creation.[242]

Through genetic enhancements, we fasten this process of evolution and, at the same time, give it a direction. Now, granted this natural propensity for change, how do we ensure that each member in a post-enhancement society, comprising humans and post-humans alike, is treated in a fair and just way? I believe that the progress reached within the mental disability advocacy, as well as within feminism and ageism can be very illuminating for this discussion. What all these movements have in common and jointly emphasize is that we already live in a world full of genotypic and phenotypic variation. However, this is not also a world that lacks moral concern and respect, or, at least, it doesn't lack the desire to recognize the relevant sources for moral concern and respect.

There are a lot of differences and variation existing between the members of the human species already. If you take a child and an adult, the looks, metabolic processes and cognitive capacities of each will be far from being considered similar, although they are part of the same species. The same will happen when setting side to side a child and an older person, or simply a man and a woman. We see the variation and acknowledge it, but, at the same time, all these distinct types of individuals are considered worthy of respect and are treated as morally equal members of the larger social group. The same applies to those suffering from mental impairments and disabilities. Now, being under-aged or gravely mentally impaired may limit one's freedom and participation in

[242] G. A. Cohen, *If You're an Egalitarian, How Come You're So Rich?* (Cambridge, Massachusetts: Harvard University Press, 2000): 46.

the life of the community, but there are reasonable arguments in favor of this particular social make-up that no reasonable person could oppose. Furthermore, these limitations do not touch upon the prevailing social attitudes toward these individuals, as bearers of human nature and, implicitly, of human dignity.

Even if we do not refer to different categories of humans and just stick to one, we will likely encounter many differences in terms of the cognitive, moral and physical abilities possessed by two 5-year-old boys or two 30-year-old women that have been randomly selected. The ultimate purpose of all these examples is to show that we already live in a world in which we constantly shift positions with respect to what we are more or less able to do. As things seem to unfold, it appears that there is room to incorporate even more variation, even if this variation would be all concentrated in the upper quartile of our abilities in the post-enhancement era. It takes quite a lot of dissimilarity to exclude an enhanced individual out of the human species and integrate her into a new one. But even if this far reaching scenario were bound to happen, respect between species could still occur. The raising interest in speciesism can testify to that end.

In order to safeguard justice in a species divided society, one need not only focus on the set-up of social institutions, but also on the prevailing social attitudes that are independent from those institutions:

> [E]galitarian justice is not only, as Rawlsian liberalism teaches, a matter of the rules that define the structure of society, but also a matter of personal attitude and choice; personal attitude and choice are, moreover, the stuff of which social structure itself is made.[243]

The importance of justice as a personal virtue and not only as an institutional one has also been discussed by David Roden in a chapter dedicated to the limits of post-human justice in a

[243] G. A. Cohen, op. cit., x

hybrid society.[244] According to Roden, this type of society would pose new ethical demands on its members, including that of constantly negotiating and redefining the concept of human identity. Following the same line, I argue that if justice is to flourish on these post-human grounds, it can only do so by means of virtuous interpersonal relations and attitudes, which, once properly cultivated, will blossom into a just institutional arrangement as well.

2. The macro-allocation problem

So far, we have established two important aspects related to the distribution of genetic enhancements: the identity of its recipients and its pattern of distribution. It is now the time to take the exploration of this topic even further by looking at the way in which the allocation of genetic enhancements would be integrated among higher decision-making principles. There are two main issues that I will focus on in this section. The first concerns the added value of each type of enhancement and the weight that they should individually receive within the distributive process. The second is centered on the distributive implications of the relationship between enhancements and their environment, between nature and nurture in bringing about a desired phenotypic trait.

There are many types of genetic enhancements that an individual could choose either for herself or for her offspring, once offered the opportunity to do so. One could opt for an increased sense of empathy, better visual acuity or the advantages of a highly athletic body. Reasonable people would agree on the value of different genetic modifications by looking at the nature of the benefits that they are most likely to bring. Thus, it wouldn't be an exaggeration to claim that having very long legs or a beautiful eye color is not quite as valuable an enhancement as boosting one's capacity for empathy or analytical abilities. The reason is not that the former enhancements are worthless, but

[244] David Roden, "Cylons in the Original Position: Limits of Posthuman Justice" in J. T. Eberl (ed.), *Battlestar Galactica and Philosophy: Knowledge Here Begins Out There* (Malden, Wiley-Blackwell: 2008).

simply that they are worth less than the latter in terms of the total value that could be attributed to them. I define the total value of an enhancement as the difference between its sum of positive externalities and the sum of its negative externalities. An externality is a benefit or a cost of an action which is incurred by agents other than the decision-maker herself. In other words, the total value of an enhancement would take into account the way in which the larger group is being affected by its members' enhancing choices.

As long as they further the realization of one's conception of the good life, enhancements are already extremely valuable. And this is, basically, the rationale behind my universal voucher proposal, meant to safeguard the interests of the individual members of society. Now, in order to take into account the needs of the larger social group as well, I argue that communal benefits represent a compelling reason for the state to subsidize, within the universal voucher system, those enhancements that have a greater total value. This perspective is also partly endorsed by Nick Bostrom:

> If in the case of intelligence enhancement the positive externalities outweigh the negative ones, then a *prima facie* case exists not only for permitting genetic enhancements aimed at increasing intellectual ability, but for encouraging and subsidizing them too. Whether such policies remain a good idea when all practicalities of implementation and political realities are taken into account is another matter. But at least we can conclude that an enhancement that has both significant intrinsic benefits for an enhanced individual and net positive externalities for the rest of society should be encouraged.[245]

Nick Bostrom's views do not completely overlap with mine, as, alongside subsidies, he also proposes a progressive tax on those 'enhancements that confer only positional advantages, such as augmentation of stature or physical attractiveness.'[246] In spite of this, the augmentation of stature or physical attractiveness count among the elements that may enrich someone's life and bring substantial benefits of a very personal nature. As such, taxing this type of choices would amount to

[245] Nick Bostrom, "Human Genetic Enhancements: A Transhumanist Perspective", *The Journal of Value Inquiry* 37 (2003): 502.
[246] N. Bostrom, op. cit.

sacrificing individual welfare in favor of collective welfare, while undermining important values like freedom, autonomy and the separateness of persons. For this reason, I only argue for the subsidization of those enhancements with a high total value and reject the extra taxation of those with a low total value. Having settled this issue, I would like to continue with an assessment of the intersectoral aspect of the distribution of genetic enhancements. As genetic enhancements are the means through which we bring about a desired phenotypic trait, we need to allocate our resources in such a way that will be consonant with our principal goal. This implies that we also need to pay attention to the environment in which the genes that we enhance exist. The question of whether we are the products of our nature or of our nurture has intrigued many generations and has sparked fierce debates fueled by passionate advocates on both sides of the barricade. In a way, genetic determinism is still lurking in the background of some of the fears brought forth by the prospective of genetic enhancement. This attitude is partially the product of the media sensationalism and fascination with 'genes for' religious beliefs, monogamy, violence, political views and many other traits that we typically tend to think of as the product of our rational choices and free will. On the other hand, environmental determinism is not dead either, but it still resurfaces in some of the widespread practices of our society, like, for instance, hyper-parenting. One worrying detail is that, many times, environmental determinism is mistaken for genetic determinism, which is a process that reinforces a skeptical attitude toward the prospects of genetic technologies. Take Aldous Huxley's *Brave New World,* which constitutes an epitome of environmental determinism, but which is routinely cited as evidence of the dangers posed by genetic determinism:

> In *Brave New World*, Aldous Huxley imagined a society in which the government manufactures five different human castes designed to perform different roles. Four decades after the publication of that dystopia, Robert Nozick developed another futuristic scenario, the genetic supermarket, to prompt discussion of the moral implications of eugenics conducted not by the state, but at the level of individuals. […] Since the 1970s, numerous authors have examined the moral implications of "designer babies," and popular films, such as Blade Runner, GATACCA, and X-Men, have also

> explored the subject. And fully five different presidential committees have dealt with ethical issues raised by the genetic modification of human beings.[247]
>
> Human nature itself lies on the operating table, ready for alteration, for eugenic and psychic "enhancement," for wholesale re-design. In leading laboratories, academic and industrial, new creators are confidently amassing their powers and quietly honing their skills, while on the street their evangelists are zealously prophesying a post-human future. […]Some transforming powers are already here. The Pill. In vitro fertilization. Bottled embryos. Surrogate wombs. Cloning. Genetic screening. Genetic manipulation. […] Years ago Aldous Huxley saw it coming. In his charming but disturbing novel, Brave New World (it appeared in 1932 and is more powerful on each re-reading), he made its meaning strikingly visible for all to see.[248]
>
> Aldous Huxley's 1932 novel *Brave New World* made the world conscious of a harsh use of genetic determinism.[249]

These quotes represent only an illustrative sample of the prevailing attitudes in the bioethics literature with respect to the alleged dangers of genetic determinism and the lack of recognition regarding nurture's reach. A very accurate and thoughtful description of this situation, directly touching on the example of Huxley's *Brave New World*, is offered by Matt Ridley in *Nature via Nurture:*

> Rarely has a book been more misrepresented than *Brave New World*. It is today almost automatically assumed to be a satire on extreme hereditarian science: an attack on nature. In fact it is all about nurture. In Huxley's imagined future, human embryos, having been artificially inseminated and in some cases cloned ("Bokanovskified"), are then developed into members of the various castes by a careful regimen of nutrients, drugs, and rationed oxygen. This is followed, during childhood, by incessant hypnopedia (brainwashing during sleep) and neo-Pavlovian conditioning until each person emerges certain to enjoy the life to which he or she has been assigned. Those who work in the tropics are conditioned to heat; those who fly rocket planes are conditioned to motion. […]
>
> Although there are drugs to keep people happy, and hints of heredity, the details of *Brave New World*, and the features that make it such a horrific place to live, are the environmental influences exercised upon the development of the bodies and brains of the inhabitants. It is a nurture hell, not a nature hell.[250]

According to Ridley, it might very well be the case for nurture to be more deterministic than nature. We cannot control our environments as children, for instance, nor our mothers' lifestyle

[247] David B. Resnik and Daniel B. Vorhaus, "Genetic Modification and Genetic Determinism", *Philosophy, Ethics and Humanities in Medicine* 1 (2006): 9.
[248] Leon Kass, "Preventing a Brave New World", *Human Life Review* Vol. 7, Issue 3 (2001): 14.
[249] Bryan Bergeron and Paul Chan, *Biotech Industry: A Global, Economic, and Financing Overview* (New Jersey: Jon Wiley & Sons, 2004): xi.
[250] Matt Ridley, *Nature via Nurture: Genes, Experience, and What Makes Us Human* (New York: Harper Collins, 2003): 150.

while pregnant. We can be held accountable, however, for the expression of certain genes through *our* dietary choices, physical activity or sleeping patterns.

The environment, in genetics, can be understood to encompass 'the external world in which the organism is located or develops, as well as the organism's internal world, which includes such factors as its hormones and metabolism.'[251]The relationship between the environment and genes is mediated by epigenetic factors that literally switch genes on and off. Such epigenetic factors are chromatin architecture (which represents the way in which DNA is packaged; a tighter packaging, for instance, renders the access of transcription factors to certain genomic loci more difficult and, as such, hinder the expression of those particular genes); DNA methylation (methyl groups, which suppress gene transcription, are added to DNA); histone modification (histones are the main components of chromatin and may be methylated, acetylated or phosphorylated, each of these chemical processes having repercussions on gene expression) and small non-coding RNAs (involved in the process of translation).[252]

In order to ensure a proper development, most human beings need more or less the same environment. Some of the major environmental influences which account for the expression of many of our genes are our gender, drugs, chemicals, temperature and light.[253] Apart from this, studies have also highlighted the importance of epigenetic switches, like maternal care in early childhood for one's cortisol levels as an adult[254], the diet of the mother during[255] and before[256]

[251] Ingrid Lobo, "Environmental Influences on Gene Expression", *Nature Education* 1 (1) (2008): 39.
[252] Rudolf Jaenisch and Adrian Bird, "Epigenetic Regulation of Gene Expression: How the Genome Integrates Intrinsic and Environmental Signals", *Nature Genetics* 33 (2003): 245.
[253] I. Lobo, op. cit.
[254] D. Liu, J. Diorio, B. Tannenbaum, C. Caldji, D. Francis, A. Freedman et al. "Maternal Care, Hippocampal Glucocorticoid Receptors, and Hypothalamic-pituitary-adrenal Responses to Stress", *Science.* 277 (1997):1659–1662.
[255] Gian-Paolo Ravelli, Zena A. Stein, Mervyn M. Susser, "Obesity in Young Men after Famine Exposure in Utero and Early Infancy", *The New England Journal of Medicine* 295 (1976): 349-353.
[256] Hozan I. Hussen, Martina Persson, Tahereh Moradi, "Maternal Overweight and Obesity are Associated with Increased Risk of Type 1 Diabetes in Offspring of Parents without Diabetes Regardless of Ethnicity", *Diabetologia* 58 (7) (2015): 1464-1473.

pregnancy, the father's lifestyle[257], the lifestyle of one's grandparents[258], as well as the traumatic events that one's parents, grandparents and perhaps even great grandparents have experienced throughout their life.[259]

If follows from all of the above that, in order to secure an adequate expression of our genes, we need to take into account many environmental and epigenetic factors throughout all our life and especially at crucial moments of our development. These latter epigenetically sensitive periods occur mostly at the embryonic or fetal stage, namely, (1) between fertilization and the formation of the blastocyst, (2) after the fifth cell cycle, which coincides with the first differentiative event, (3) during the early phase of differentiation and (4) during oocyte growth.[260] The disruption of this process poses great developmental risk to the health and well-being of the child, once born.

There are two implications that environmental and epigenetic factors have for a theory of justice. First, most human beings require a similar type of environment in order to flourish. Unpolluted air, maternal affection or a good nutrient intake are valuable for most of us, although to varying degrees. For instance, the carriers of the low-activity MAO-A gene, which is correlated with an increased incidence of antisocial behavior, could benefit even more from maternal care and an affectionate environment during childhood than the rest. But this does not amount to saying that maternal care is not significant for everybody else. It simply shows that the lack of it is associated with different outcomes, depending on one's set of genes. There are, of course, some cases when our genomes command a slightly altered environment than the mainstream one in order to ensure our health and well-being. I'm referring to situations like celiac disease, which is characterized by a

[257] Adelheid Soubry, Cathrine Hoyo, Randy L. Jirtle, Susan K. Murphy, "A Paternal Environmental Legacy: Evidence for Epigenetic Inheritance through the Male Germ Line", *Bioessays* 36 (2014): 359-371.
[258] Gunnar Kaati, Lars Olov Bygren, Marcus Pembrey, Michael Sjostrom, "Transgenerational Response to Nutrition, Early Life Circumstances and Longevity", *European Journal of Human Genetics* 15 (2007): 784-790.
[259] Natan P.F. Kellermann, "Epigenetic Transmission of Holocaust Trauma: Can Nightmares Be Inherited?", *Israel Journal of Psychiatry and Related Sciences* 50 (1) (2013): 33-39.
[260] T. M. Nafee, W. E. Farrell, W. D. Carroll, A. A. Fryer, K. M. K. Ismail, "Epigenetic Control of Fetal Gene Expression", *An International Journal of Obstetrics and Gynaecology* 115 (2) (2007): 158-168.

high sensitivity to gluten, or phenylketonuria, which produces an impaired metabolism of phenylalanine. However, even those suffering from these two conditions need what most individuals need for proper development, minus gluten or phenylalanine. The fact that we all require, more or less, the same environment in order to thrive facilitates the planning and the implementation of public policies in this area. It also protects private genetic information by not grouping individuals in schools, hospitals or other institutions according to their genetic make-up. In the end, the policies targeting one's genetic environment, when successful, will create two types of goods: (1) collective and indivisible goods, like clean air and a radiation-free natural environment, alongside (2) goods of a more private nature, concerning the specifics of one's upbringing, family environment and *in utero* life. Both of this kind of policies are already implemented to a certain extent. There are international bodies concerned with the regulation of air pollution. There are social services that monitor the cases of child abuse and neglect. There are legal consequences for pregnant women who test positive for the use of narcotics. There is even widespread social opprobrium whenever a pregnant woman smokes cigarettes or drinks alcohol, although no judge could legally sanction her for this behavior. One important fact that needs to be emphasized here is that it appears that the environment of our genes is more important for genetic treatment and prevention than it is for enhancements. In a way, a good environment is a necessary prerequisite for genetic enhancement, but not exactly something that complements it. What this shows is that, in order to spend resources wisely, one needs to secure that the preconditions for genetic enhancements, such as a good environment and a satisfactory state of health, are met. As our environment touches upon so many aspects of our lives, the burden of funding public policies in this area will fall on a diversity of institutions. The fact that there are overlapping interests and already existing channels to deal with the needs of our genetic environment leads to the following conclusion: most of the resources

dedicated to genetic enhancements should be directed toward funding the enhancing procedures themselves.

Having answered these questions, a second issue emerges. Given everything that we know about epigenetics and the importance of our ancestors' lifestyle for our healthy development, are there sufficient grounds for considering a pregnant woman's decision to smoke a matter of justice? Or, for that case, any person's decision to smoke or to eat unhealthy foods, as all of our lifestyle choices will impact, in the end, the well-being of our descendants? There are strong reasons for treating lifestyle as one of the objects of justice: the harm principle and the causal relationship between present life choices and the health and well-being of the people living in the future. However, these reasons are not sufficient, due to one very important intervening element: individual freedom and autonomy. We are not merely the prospective incubators of the people that will come into existence at one point or another. We have our own desires, preferences and views about the good life, although some of them might prove to be objectively incorrect. In the end, smoking is not bad for one's descendants only, but also for the smoker herself. Given this, even the harm principle can be read in a more malleable way:

> The only part of the conduct of anyone, for which he is amenable to society, is that which concerns others. In the part which merely concerns himself, his independence is, of right, absolute. Over himself, over his own body and mind, the individual is sovereign.[261]

Now, the problem with epigenetics is that *anything* that we do will concern others as much as it concerns ourselves. There is absolutely no personal sphere that is left untouched. Even our cells cease to be ours alone because at one point in the future they might be part of a new, yet non-existing person. Liberty, autonomy, the need for privacy and the horror of only imagining a scenario in which the state could legally sanction someone for having two desserts in one day jointly

[261] John Stuart Mill, *On Liberty* (Oxford: Oxford University Press, 1859): 22.

contribute to removing lifestyle out of the reaches of a theory of justice. In spite of this, the potential for harm remains, which does transform our unfortunate lifestyle choices into wrongful actions. Consequently, I argue that all the factors that influence the epigenetic ties between generations are not a matter of justice, but a matter of ethics. As such, it is ethically desirable to take into account the interests of the future generations and to act accordingly. Furthermore, public policies that would foster individuals' epigenetic education are highly encouraged.

Conclusion

I have argued in this chapter that a just distribution of genetic enhancements could be achieved by allocating enhancing vouchers to all the members of a society, including children and the yet unborn. The rationale behind this approach is that all persons, as moral equals, deserve a fair opportunity to realize their conception of the good life, while children and future children should benefit from a reasonably good enough start in life. By looking at the effects of individual enhancements on the larger social group, I propose the subsidization of those procedures that bring the greatest collective gains. I emphasize the importance of the environment as a precursor for the materialization of the goals of genetic enhancements. Finally, I argue that epigenetics and one's lifestyle do not constitute adequate topics for a theory of justice - distributive or intergenerational -, but they do represent a fertile ground for ethical scrutiny.

CONCLUSION

Begin at the beginning and go on
till you come to the end; then stop.
(L. Carroll)

It is important to think about the future generations. It is important because we can, because there is no one else out there to do the task and, ultimately, because every single person who has ever existed or will come to exist, started off like this: as a member of a future generation. It is not easy to think about future generations, though. Not when real people in the real world are facing terrible problems. Not when resources are scarce and one needs to prioritize. Not when we don't know who the future generations are, what they would value or what they would disvalue. In spite of this, however, many attempts have already been made in order to secure fair intergenerational relations. Suffice to look, for instance, at the achievements within environmentalism and constitutionalism, which point to an important norm: the difficulty or ease of an enterprise should have no decisive say on its moral desirability. My aim, in this thesis, was to follow a similar line and to analyze the potential well-being of future generations, together with our moral and justice-based duties toward them, in the area of genetic engineering.

The first question that I had to deal with while building my intergenerational account was that of properly defining the concept of future generations. This term is so heavily used within the bioethics literature up to the point that it's starting to be abused. I argue that not all future people should be considered, by default, part of the future generations. Thus, future generations are characterized by several specific traits. First of all, they are not actual, meaning that they do not exist

in the present. Second, they are indeterminate, in the sense that we do not know who they are or who they will be. However, it is certain that future generations will come into existence at one point. At the same time, they have potential interests that the present generation can affect. These properties can help us differentiate between future generations and the other two types of future people, namely, fetuses and unborn members of an identifiable family line.

I proceeded next to the classification of genetic interventions according to their aim, object and time. The two types of genetic manipulations that raise the biggest moral challenges, from the perspective of future generations, are those targeting the germline and enhancements. These are the reasons why. Unlike somatic interventions, germline procedures are more problematic because their effects are not restricted to the individuals undergoing the procedure, but they also extend to their descendants. This very important aspect raises a host of moral and scientific questions. As far as enhancements are concerned, it is the moral stringency of their performance that makes them the most relevant procedures for a discussion regarding future generations and their well-being. Treatment and prevention are linked to types of harms that affect more the current generation. For instance, genetic treatments are meant to alleviate the pain and suffering associated with an existing, actual harm, while preventative measures tackle the probable occurrence of a future harm. When it comes to enhancement, however, there is no actual, nor potential harm that we need to take into account. Enhancement upgrades someone's capacities from good to better. It is a supererogatory act rather than a stringent moral demand for the current generation, which makes it a fertile ground for taking into account the interests of future generations.

I have argued in Chapter 2 that germline interventions aimed at modifying the genomes of future people cannot be scientifically, nor morally justifiable if there is no possibility of controlling the intervention either by reversing or altering it, whenever need demands it. Performing germline modifications on currently living individuals may target future generations' health and the well-being

associated to it by reducing the diversity of the human gene pool. This can have two negative repercussions: (1) reduction of heterozygosity, which is associated with a health or performance advantage; (2) uniformization of the genes involved in reproductive recombination, which may lead to the health risks involved in asexual reproduction.

In order to discuss the moral implications of genetic enhancements for the future generations, I first provided a definition of enhancement that would not only capture the core of the concept itself, but also situate it in the medical axis, alongside treatment and prevention. Thus, I define human enhancement as (i) an improvement that is dependent upon its starting and end points in such a way that it needs to evolve from good – or normal - to better; (ii) an improvement that is dispensable to a good state of health; (iii) an improvement of a human capacity and not solely an upgrade in task completion; (iv) an improvement of a human capacity that does not necessarily coincide with an overall, systemic upgrade. I adopt the pure state account's overview of normality, which was exposed in Chapter 3, in order to define enhancement and separate it from treatment and preventative measures.

Because human medical enhancement has sparked so many ethical controversies, I have dedicated Chapter 4 to the exploration of the main arguments that are usually formulated against it, such as, the appeal to excellence and to the relation between means and ends, the claim that enhancement would distort human normality, that it would violate and destroy human nature, the charge of hubris, of altering one's identity and authenticity, of incentivizing the misprioritization of resources. In many cases, the moral attitudes arising from discussing the implications of enhancing technologies turned out to reveal certain ethical problems existing at deeper social levels and that were brought back to the surface by enhancement debates. In other cases, enhancements and their promises were misunderstood, distorted by the 'yuck factor' and, consequently, falsely problematized. Still in others, enhancing technologies appear to be the solution to the concerns

raised by their very critics. Given all of this, I concluded that human medical enhancement, in itself, did not constitute a compelling reason for moral worry.

I identify four main areas in which genetic enhancement may come to influence the lives of the future people: (i) collective action problems; (ii) impact on global risks; (iii) utopic singularity; (iv) social configuration. Genetic enhancements could, indeed, be prone to collective action problems, but I argue that even if some upgrading technologies have the potential of hurting the collective, the opportunity cost of not putting them to use is higher. When it comes to risks, I claim that genetic enhancement could enable future generations to find themselves on a good developmental trajectory so that they successfully meet global and existential challenges. Finally, genetic enhancement could, in principle, lead to an elevated state of well-being for both present and future generations through its direct and indirect effects. In the end, genetic enhancement is most likely our safest bet toward reaching utopia.

As far as social justice is concerned, I propose allocating enhancing vouchers to all the members of a society, including children and the yet unborn. The rationale behind this approach is that all persons, as moral equals, deserve a fair opportunity to realize their conception of the good life, while children and future children should benefit from a reasonably good enough start in life. By looking at the effects of individual enhancements on the larger social group, I recommend the subsidization of those procedures that bring the greatest collective gains. I emphasize the importance of the environment as a precursor for the materialization of the goals of genetic enhancements. Finally, I argue that epigenetics and one's lifestyle do not constitute adequate topics for a theory of justice - distributive or intergenerational -, but they do represent a fertile ground for ethical scrutiny.

These are, in brief, the findings of my thesis. The main takeaway can be unfolded into two types of arguments. On the one hand, we have moral and justice-based duties to consider the

interests of future generations and to act upon those considerations whenever the costs allow us. This is, basically, the case of genetic enhancement. On the other hand and in spite of the fact that everything that we do or fail to do affects the future, there are some types of genetic procedures, like germline manipulations, that directly and unambiguously interfere with the lives of the generations to come. This blunt interference gives us enough ground to include future generations among those deserving our moral concern and care.

As knowledge and technology progress, there are uncountable ways in which the arguments presented in this thesis could potentially become stronger and more compelling. I am especially curious to witness in the years to come the evolution of epigenetics, which I assume that will continue to reshape the contours of intergenerational relations in extremely meaningful ways. Privacy in the era of genetic information is another rich area that promises to deliver interesting questions and, hopefully, equally interesting answers once genomic sequencing becomes mainstream. Anti-aging and life extension research constitutes a topic that has, somehow, always been on my mind while writing this thesis but to which I have never specifically referred. I used it more as an undisclosed example while thinking about the future successes of medicine or future risks, like resource depletion and overpopulation. However, I do think it's a very exciting field that is advancing at a fast pace and which is in great need of moral defense, both for the sake of the current and future generations.

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