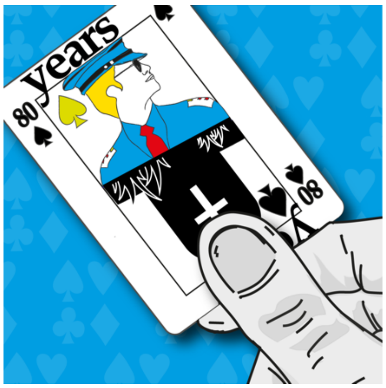
The Future Human Life

Edited by **V. Menuz, J. Roduit , D. Roiz, Alexandre Erler, N. Stepanova**







Introduction : The Future Human Life

The Editorial team

Recent technological progresses have made technological modifications of human beings a real possibility. Some physical, cognitive and/or psychological traits may soon be artificially radically enhanced. Such a scenario has already started. Just think how your smartphones have given you the power of geographical positioning and telepathy, through Global Positioning System (GPS) and Short Message Service (SMS) respectively. Many commentators have postulated that technological modification of human beings will become more and more common (Kurzweil, 2005). While some have postulated that it will be the only way for occidental citizen to be able to live in the fast changing technological environment we are continuously creating (Harris, 2007; Powell and Buchanan, 2011), others have warned on the many socio-economical pressure that may compel individuals to continuously seek to be adapted for such an artificial environment (Menuz, 2015). This is an illustration of the many socio-ethical issues raised by *human enhancement*. Such issues have started to be seriously addressed by scholars around the world, as illustrated by Oxford and Cambridge Universities (UK) that have both created institutes dedicated to the many issues related to the use of modern technology for modifying individuals[1]. However, while lay people may soon make technological choices in order to enhance them or their children, they have been largely overlooked in the debates, which have, for now, mainly been restricted to academics. That is quite

[1] http://www.fhi.ox.ac.uk/ and http://cser.org/ respectively, accessed December 17th, 2015.

paradoxical, because the many socio-ethical issues related by human enhancement concern everybody living in our societies.

We strongly believe that it is time for lay people to be implicated in the discussions. To do so, one of the first needed steps is to give them some insight into the academics debates. This book, written by international young researchers from different academic fields (philosophy, sociology, anthropology, law and biology), is an insight into some the socio-ethical issues related to human enhancement that are discussed by academics. These authors propose an analysis of the current and near future possibilities of human enhancement from different perspectives, ranging from a philosophical to a legal point of view, as well as getting insights from enhancing technologies that are already challenging the way we do and see sports, the way we guide our scientific discoveries, and the way we tackle age-related diseases.

In order to be constructive, the debate addressing socio-ethical issues related to human enhancement needs diversity, as proposed in this book. First, different ethical outlooks need to be represented for it to truly count as a debate. It seems fair to say that the various contributions to this volume do just that. While a number of them favour a middle ground between clear-cut "*pro*-enhancement" or "*anti*-enhancement" positions, some authors raise a number of societal concerns about the rise of human enhancement technologies, or suggest legal prohibitions in cases where some people would feel coerced into using them or would derive significant advantages from them not available to all (Chapter 2). By contrast, others provocatively argue, on grounds of fairness, against the existing bans on performance human enhancers in competitive sport (Chapter 5). Giving voice to such a diversity of ethical perspectives is a central goal of *Future Human*

Life not only can this help ensure that the debate on the socio-ethical issues related to human enhancement will be democratic in nature, but we also believe that the strongest arguments on both sides should be heard, in order to raise the level of that debate and help everyone interested form their own opinion on those matters. Secondly, the debate calls for a diversity of disciplinary approaches. The contributors to this volume provide us with this as well. They thus bring a background not only in ethics, but also in Greek mythology (Chapter 4), law (Chapter 2), theology (Chapter 3), history (Chapter 1), evolutionary biology (Chapter 3), social science (Chapter 6) and epigenetics (Chapter 8). Chapter 7's mention of the rise of artificial intelligence is also very important. Computer performance is, after all, a dimension that has followed a trajectory of exponential growth over the past half-century or so (what is known as "Moore's Law"), and if this trend continues for at least a few more decades, it might eventually spell the dawn of *superintelligent* machines, a truly revolutionary development that could, among other things, help open up new, radical paths to human enhancement.

This convergence of different disciplines is necessary if the debate addressing the socio-ethical issues related to human enhancement is to be properly empirically informed and, ultimately, socially relevant. Hopefully we will see more of it in the years to come. In the meantime, we hope that this volume will serve as a useful introduction to the many issues raised by human enhancements for newcomers, and that it will stimulate reflection among all readers on a topic that should increasingly have a bearing on their lives as we move further into this fascinating century.

References

Harris, J. (2007). Enhancing Evolution: The Ethical Case for Making Better People (Princeton University Press).

Kurzweil, R. (2005). The Singularity is Near: When Humans Transcend Biology (Viking).

Menuz, V. (2015). Why do we wish to be enhanced ? In Inquiring into Human Enhancement : Beyond Disciplinary and National Boundaries, (Londre, GB: S. Bateman, J. Gayon, S. Allouche, J. Goffette and M. Marzano).

Powell, R., and Buchanan, A. (2011). Breaking Evolution's Chains: The Prospect of Deliberate Genetic Modification in Humans. J. Med. Philos. *36*, 6–27.

Illustration 1 "In Search of the Elixir of Youth" by N. Stepanova

Chapter 1: In Search of the Elixir of Youth

Indrani Gupta, Kristina Kakalacheva, Enrica Saponara

"Live everyday as if you were to die tomorrow"

Mahatma Gandhi

What would it be like if we were not to die tomorrow, the day after tomorrow or even for the next 100 years or more? What would life be like if we were immortal and could live forever? A recent poll asked American citizens whether they would like to live to be 120 years old. The results were striking: although these respondents were eager to extend their life expectancy by another decade or so, more than fifty percent were ready to refuse a treatment that would extend their lives beyond 120 years of age (Pew Poll 2013). We asked the same question to Professor Yves Barral, whose research explores the processes of aging in yeast (*S. cerevisae*), which is a single-cell organism that is widely used as an experimental model in biology. He believes that any interference with human aging might alter the beneficial aspects of this natural process: *"Personally, I don't think I would like to live for 120 years or more. I live now. I live in the present. (…) As we see in the case of yeast, aging is not only bad, but it also has some beneficial effects such as 'memory' and 'experience'. By circumventing aging our cells might accumulate many more damaging effects."* The main purpose of Professor Barral's research is not to find a cure for aging but instead to analyze nature's complexities and elucidate the underlying mechanisms of why we age.

The results of the poll and Professor Barral's perspective are surprising; however, throughout history, the yearning for immortality has set many philosophers, scientists and dreamers alike on the quest for the "Fountain of Youth". With the current blinding speed of technological progress, which has unquestionably improved the manner in which we live, we may wonder whether science and technology will one day advance to such an extent that they will radically increase our lifespan and (why not) even make us immortal.

This scenario may resemble science fiction, but a quick examination into recent history illustrates how lifespan and human life expectancy have considerably increased over time. Contrary to common assumptions, humans in the Stone Age did not have an extremely short lifespan. They did, however, have a much lower life expectancy. In contrast to the lifespan measure, which is the length of time for which a species lives and is determined by the biological specificities of a species, life expectancy is an average value that represents the number of years to which people may expect to live. Life expectancy in the Stone Age was heavily influenced by infant mortality, which was somewhat common at the time. Therefore, on one hand, although the inhabitants of the Stone Age had a life expectancy of only 30 years, most who survived childhood had excellent chances of living to 55 years of age. The Agricultural Revolution that followed, on the other hand, brought with it the problems associated with settled populations, including water contamination and epidemic diseases such as cholera, smallpox, polio and influenza. Life expectancy during that period was approximately 38 years (Goscienski 2003). Despite the subsequent urbanization and development of the Medieval and Victorian periods, life expectancy did not increase beyond 40 years of age primarily because of rampant malnutrition and epidemic diseases. Not until the medical advances of the 1900s did life expectancy dramatically increase to 70 years.

The social and technological developments that have occurred over the last century have more than doubled life expectancy. A child born today in Japan – a country with one of the highest life expectancies in the world – is projected to live more than 85 years. The current upward trend in life expectancy in most industrialized countries is estimated as the addition of 2.5 more years of life with every decade. If this trend continues at the same pace, it will take only 60 more years for our descendants to reach a life expectancy of 100 years (Bostrom and Roache 2008).

The factors that have contributed to the last century's dramatic increase in human life expectancy are linked to medical progress (mainly in the use of vaccinations and antibiotics), improved sanitation and hygiene, richer nutrition and better education. Such an enhancement of human life expectancy might therefore be considered as the result of technological developments. If these are the factors that have contributed to increasing life expectancy in the past, one might wonder what will be the factors that sustain or even accelerate this upwards trend into the future.

Chronic age-related diseases, including cardio- and cerebrovascular disorders, cancer and renal failure, are the leading causes of death among the elderly (WHO 2013). Nevertheless, the aim of increasing life expectancy does not necessarily mean prolonging life with chronic age-related diseases. Instead, increasing life expectancy should aim at minimizing the effects of age and age-related diseases by increasing a person's health span, which can be defined as the years during which a person is healthy. But how can we achieve such a goal?

Aubrey de Grey, a theoretical gerontologist, proposes that aging and everything related to it can be reversed by "engineering senescence". According to his theory, "implementing a series of periodic medical interventions designed to repair, prevent or render irrelevant all types of molecular and cellular damages that cause age-related pathology and degeneration, may avoid debilitation and death from age-related causes" (de Grey and Rae 2007). Ending Aging: The

Rejuvenation Breakthroughs that Could Reverse Human Aging in Our Lifetime. New York, NY: St. Martin's Press, 416 pp. ISBN 0-312-36706-6].

However, a study that estimated the additional years that curing age-related diseases would bring points in a different direction. Thom and colleagues discovered that curing the number one cause of death in the developed world – cardiovascular-related disease – would add only seven years to a person’s life expectancy, whereas curing all cancers would contribute only three additional years. Obliterating cardiovascular disease and cancer altogether would prolong one’s life expectancy by approximately nine years (Thom 2006). Hence, rather different strategies should be deployed to radically increase our life expectancy.

One such strategy might be to find methods for slowing down the aging process as a whole. To achieve this objective, scientists first must better understand the most minute details of the biological process of human aging and pinpoint the molecular targets that can stop or even reverse these processes. Currently, gerontologists – scientists who specialize in studying aging – are divided between two theories of aging; however, no unequivocal answer to the question of “why we age” has yet been found.

The first theory posits that, after our reproductive and parenting years, organisms undergo progressive wear and tear in their elementary biological constituents. This theory postulates that this damage can be caused by environmental factors such as exposure to radiation, toxins, ultraviolet lights, and infectious diseases, all contributing to functional errors and the accumulation of damage in the body that ultimately leads to aging.

The second theory is called “programmed longevity”, and it suggests that longevity – the maximum number of years an individual of a given species can live – is biologically pre-defined and genetically regulated. According to this theory, the aging process is controlled by the body, which switches on a particular biological program of senescence. Therefore, aging should be understood more as a natural, pre-determined process of programmed degeneration rather than as wear and tear on the body. This second theory thus considers senescence to be a necessary part of evolution. Without aging and eventual death, there would be no pressure on the individual to survive and reproduce and consequently no evolution of the species (Prinzinger 2005). If science progresses to the point that it is able to counteract the biological mechanisms that underlie aging and that lead an organism to a state of "negligible senescence", then a paradox of biology and evolution will have occurred.

Although aging is to a large extent determined by our genes, which regulate the predetermined senescence of our bodies, genetics is not the only factor that influences aging. Our environment – including the food we eat, our physical activity and our exposure to harmful chemicals and infectious diseases, among other components – exerts an essential influence on our biological functioning and plays an important role in how we age.

Calorie restriction – or the reduction of food intake – is a lifestyle-dependent anti-aging strategy that has attracted considerable attention recently. In the 1930s, it was shown that food restriction could extend the lifespan of laboratory rats by as much as 40 percent (McCay and Crowell 1934]. A 20-year-long study completed in 2009 confirmed the benefits of calorie restriction for lifespan extension and the delayed onset of age-associated diseases in primates, suggesting the same might hold true for humans (Colman 2009). However, the applicability of such a diet as a therapy against aging in humans is questionable. Nonetheless, thousands of people around the world are currently practicing calorie restriction. One example is the strictly ascetic members of the Calorie Restriction Society in the United States. Are people prepared to follow a strict dietary program that is based on low-calorie intake to achieve the promise of better health and longevity? Whereas laboratory animals can be confined to restricted and controlled food supply, one cannot expect that humans would be able – or simply wish – to resist the constant temptation of the surplus food around us. Furthermore, the concept of a calorie restriction diet not only entails eating the right type of food in the appropriate amount but also implies that protein, essential fatty acids, vitamins, and minerals would be combined to form a well-balanced diet. Therefore, the correct amount of calories must be calculated without ending up in a malnourished and vitamin-deficient state. Finally, it would also be interesting to determine whether the developed world culture of over-abundance and encouraged consumerism will allow us to undertake such a dramatic lifestyle change. Again, scientists might hold the answer to achieving this goal. Drugs that mimic the effects of calorie restriction are currently under study. It may not be long before we might be able to take a pill and enjoy a rich and unhealthy meal while tricking our bodies into healthy youth. Nonetheless, the ability to easily neutralize our misbehavior might challenge our will power and our capacity ability to take responsibility for our lives.

In addition to attempting to reverse the aging processes of the body's tissues, aged body parts might simply be replaced by completely new and compatible parts. Heart bypasses, artificial joints and organ transplantation have existed for years as means of repairing broken parts. However, they are frequently associated with poor compatibility or even rejection by the recipient organism. For this reason, scientists are currently striving to characterize a special type of cells called stem cells, which are believed to be the fundamental units of regeneration. Stem cells are an undifferentiated type of cell with two remarkable properties: they can renew themselves through cell division and can also differentiate into a great variety of specialized cell types to constitute bodily organs such as skin and the heart. In many tissues, including the stomach and bone marrow, reservoirs of stem cells serve as an internal repair system. Is it possible that we may one day develop the ability to renew our bodies indefinitely?

Harnessing the potential of stem cells to renew malfunctioning organs is an objective aimed at by many research groups. However, research on stem cells has sparked some controversy. The use of embryonic material – which has been the primary source of stem cells – has raised fervent resistance in the past, mainly from religious and conservatives groups. To overcome the ethical concerns related to the use of embryonic stem cells, scientists are studying methodologies to generate stem cells by reprogramming differentiated adult cells. The idea is to take the patient's differentiated skin cells, revert them back into stem cells (also called induced pluripotent stem cells or iPS) and program them to differentiate themselves into specialized cells, such as hepatocytes, which can be injected into the person's liver to repair its functions. Whereas rejection of foreign organs is commonplace in organ transplantation, one particular advantage of iPS therapy is that the recipient is not expected to reject the newly generated organ because it is made of his own reprogramed cells.

As a result of scientific technologies such as those discussed above, it might be imagined that gaining 25 to 50 more years of life could result not in the mere addition of these years to our mature age but in the extension of each individual stage of our lives. We perhaps would then have more time to enjoy childhood and more time for educational development. We might even be able to spend one-half of our lives engaging in one profession and the other half in a completely different occupation or would simply have more time for our families and hobbies.

In reconsidering the possibilities of lifespan extension through genetics, lifestyle changes, or stem cell therapy, the myriad questions that our society will ultimately have to face is baffling:

How can we sustain the pharmaceutical costs generated by the extra medical care necessary to prevent aging, to circumvent diseases and to guarantee optimal nutritional balance? Are we prepared to handle the social impact caused by a population living longer? We already face problems such as economic recessions and unemployment. What would these problems be like when older people hold onto their jobs and resources for even longer?

Last but not least, these supreme social and medical standards have always been part of the luxury package of the richer part of the world. When the rich can extend their lives and the poor cannot, the gap separating these two groups will grow, pulling these social categories further apart.

Lifespan extension, however, may lead to a distortion of the rules of social coexistence, allowing for behaviors that are presently considered amoral, such as old-age pregnancy. Currently, giving birth above the age of 60 is the topic of debate: what if 60 turns into the new middle-age? The same conundrum affects the question of euthanasia: currently, this practice is the topic of heated debate by religious groups and ethicists and is considered an artificial way of discontinuing a life that is unable to be enjoyed and healthily lived. However, what if one simply grows tired of life after becoming immortal? Would euthanasia become the means by which life is brought to an end?

It is difficult to say whether the ability to extend our lives in the future would be a boon or a curse to mankind. If scientists are able to clear the hurdles of the research challenges involved and devise an ultimate panacea, i.e., lifespan extension, one final challenge will likely remain before us: tackling the social and moral implications of such an ultimate power.

References

Bostrom, Nick and Rebecca Roache. 2008. “Ethical Issues in Human Enhancement.” In *New Waves in Applied Ethics*, 120-152, ed. Jesper Ryberg, Thomas Petersen and Clark Wolf. Basingstoke, UK: Palgrave Macmillan.

Colman, Ricki J., and Rozalyn M. Anderson, and Sterling C. Johnson, and Erik K. Kastman, and Kristopher J. Kosmatka, and T. Mark Beasley, and David B. Allison, and Christina Cruzen, and Heather A. Simmons, and Joseph W. Kemnitz, and Richard Weindruch. 2009. “Caloric Restriction Delays Disease Onset & Mortality in Rhesus Monkeys.” *Science* 325 (5937): 201–4.

de Grey, Aubrey and Michael Rae. 2007. *Ending Aging: the Rejuvenation Breakthroughs That Could Reverse Human Aging in Our Lifetime*. New York, NY: St. Martin's Press, 416.

Goscienski, Philip J. 2003. *Health Secrets of the Stone Age: What We Can Learn from Deep in Prehistory to Become Leaner, Livelier, and Longer-Lived*. Cookeville, Tennessee: New Century Books.

McCay, Clive M. and Mary F. Crowell. 1934. “Prolonging the Life Span.” *The Scientific Monthly* 39 (5): 405-14.

Pew Poll. 2013. “Living to 120 and Beyond - Americans’ Views on Aging, Medical Advances and Radical Life Extension.”

Prinzinger, Roland. 2005. “Programmed Ageing: the Theory of Maximal Metabolic Scope. How Does the Biological Clock Tick?” *EMBO Reports* 6 (S1): S14–9.

Thom, Thomas. 2006. “Heart Disease and Stroke Statistics—2006 Update: a Report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee.” *Circulation* 113: e85-e151.

WHO. “Deaths: Final Data for 2013”.

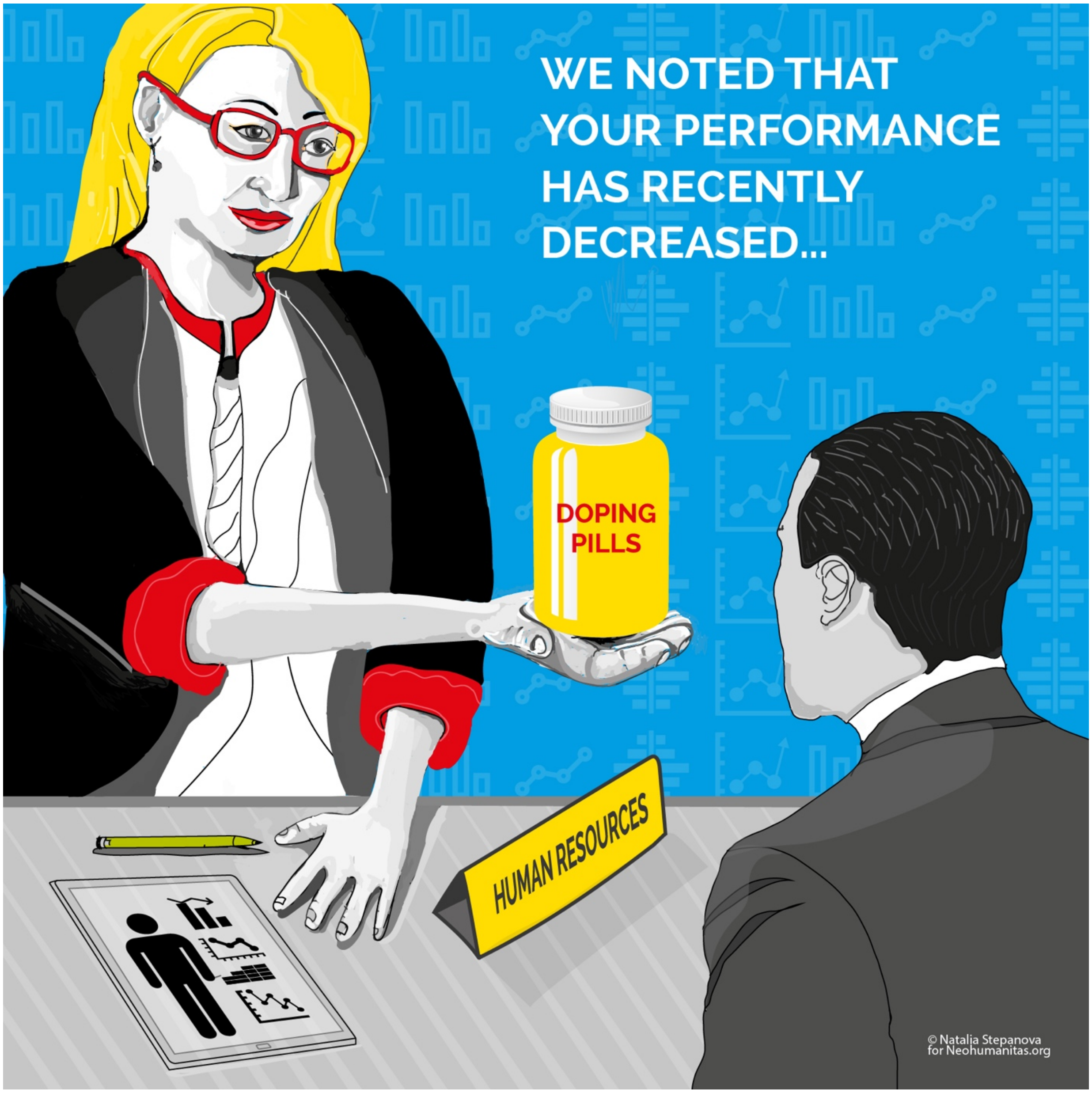


Illustration 2 "Enhancing human enhancement: a legal perspective" by N. Stepanova

Chapter 2: Enhancing human enhancement: a legal perspective

David Shaw

"There are fascinating ethical questions about human enhancement, but it is often forgotten that it is ultimately the law which will decide how these issues are dealt with" (D. Shaw)

Much of the discussion regarding human enhancement has focused on ethical issues. Should we make ourselves smarter using pills? Is it ethical to allow athletes to "dope"? Is it right to bestow particular qualities upon our children through the use of technology? These are fascinating questions. However, it is often forgotten that it is ultimately law, rather than ethics, that will finally decide how we must address these issues. The law is frequently accused of lagging behind technological and pharmaceutical developments, which appears to be even more likely to occur in the case of human enhancement, where both science and the ethical debate are moving rapidly. We might wonder whether the law will successfully anticipate and regulate the cutting-edge questions posed by the utilization of technologies for enhancing humans. In this chapter, I examine how *natural*, *national* and *international* laws address issues related to human enhancement.

Natural law

Some of the oldest objections to human enhancement derive from the concept of “natural law”. In essence, natural law attempts to determine moral rules using basic facts about human “nature” and “function”. Natural law is conceived of in contradistinction to “positive law”, i.e., the rules established by various societies. It has been argued that natural law entails that many forms of human enhancement should be outlawed because the very aim of enhancement is to alter individuals’ natural biological state (Anderson and Tolefson 2008). However, it can also be argued that the very nature of human beings is to find solutions that improve who we are, including our natural biological state. We are constantly attempting to improve ourselves by learning new facts and skills through new experiences. In this sense, we can even argue that education itself is a form of human enhancement (Harris 2007), and few supporters of natural law would argue against education. Although it is often claimed that human enhancement is “unnatural” (Anderson and Tolefson 2008), this statement has little legal or ethical force. For example, hospitals and schools are not natural – they are human-made institutions – but we use them because they provide us clear benefits. Thus, based on the principles of natural law, it can be argued that education and healthcare are forms of human enhancement. Natural law may seem to be interesting from a theoretical perspective, but it does not provide any useful information on how to address human enhancement in practice.

National laws

Various national laws already tightly regulate one form of medical intervention that has been considered by some to be human enhancement: plastic surgery (Stern 2013). Although initially developed for therapeutic purposes (such as restoring function after an accident or a disease), the use of plastic surgery for aesthetic enhancements – hereafter referred as "cosmetic enhancement" – soon became popular all over the world. Given the potentially dramatic side effects of such interventions (even a "nose job" might result in a heart attack or a blood clot), cosmetic enhancements are strictly regulated to protect patients against risky and ill-advised medical practices. Despite some notable behavior involving misconduct such as the "Poly Implant Prothèse" scandal in France (Willsher 2013), this regulation has largely been successful.

Although cosmetic enhancement runs the risk of undesirable side effects, other forms of human enhancement through technological modifications might have clearly beneficial effects on health. For instance, it has been observed that people from wealthier backgrounds tend to be healthier than those from poorer backgrounds (Shaw 2014). If people who grow up in poorer areas tend to die younger because of their lower quality of life and lower levels of education, we may wonder whether providing them with cognitive enhancers might help them make healthier choices, which would reduce health inequalities between rich and poor. In other words, cognitive enhancement might be used as a means of improving public health (Shaw 2014). Any such intervention would necessitate governance by means of a legal framework, particularly if it were available to everyone, as is the case in the USA with fluoride-enhanced public water supplies (Shaw 2012).

We should examine other types of technologies that may lead to human enhancement. First, extending our lifespan by fighting diseases is one of the most widely accepted objectives of our industrialized societies. However, extending our lifespan substantially using the new tools offered by modern technology poses certain problems that may require legal regulation. For example, what might be the impact on societies if the average lifespan were increased up to 1,000 years through the use of life-enhancing technologies? Such a scenario might make it necessary for countries to create new laws to prevent the public from using such life-extending technologies to limit the impact on medical and natural resources (and on the environment through increased CO_2 emissions). Denying public social care for such technology would likely be relatively easy. However, legislation might also be required to prevent the private use of such life-extending technologies to prevent the emergence of a two-tier system in which the very rich could live very long and healthy lives, whereas ordinary people could not. Second, many countries already have laws governing pharmaceuticals that enhance humans. For example, certain drugs that improve alertness and other cognitive abilities – such as methylphenidate (Ritalin), for example – are available in most industrialized countries only by prescription. Most of these laws have been enacted for safety reasons because there is not yet sufficient data on the potential side effects of pharmaceutical "cognitive enhancers" and because they might become addictive if overused. Whereas current laws and regulations govern the use of cognitive enhancers for therapeutic purposes quite well by making them available only by prescription, they might also be used "off-label" by individuals aiming to enhance certain of their cognitive abilities rather than to treat the disease or health problems for which the drug was developed. From a "risk/benefit" perspective (i.e., balancing the risks *vs.* the benefit that these drugs may have on those using them), the use of such a drug might be considered more "risky" for healthy people due to the unpredictable and (perhaps) undesirable side effects associated with the pharmaceutical than such use would be for people who require the drug to restore normal function. In other words, taking the risk of the side effects to restore "normal functioning" might be worth it; however, taking such a risk to improve cognitive skills beyond what might be considered "normal" might not be worth it. In this regard, regulation and legislation should be developed to regulate such off-label use of drugs in a way that also permits the responsible use of enhancement.

New laws may also be required to prevent “enhancers” from being used unfairly. For instance, some educational institutions (Lamkin 2011) are already considering banning the use of “cognitive enhancers” such as Ritalin by their students during exam periods because of the unfair advantage such drugs may offer. In addition, it has previously been suggested that some types of “enhancers” should only be available to people who obtain “enhancement licenses” that indicate that they understand the risks of using such “enhancers” and who agree to take them only if doing so does not jeopardize the integrity of their own life and/or the lives of others.

Furthermore, if human enhancement becomes common practice in the workplace, then new laws will have to be designed and implemented. On one hand, it might be necessary to regulate employers who try to force their employees to use “enhancers” to improve efficiency. For example, factory workers might be expected to take pharmaceutical cognitive enhancers to counteract tiredness and fatigue and enable them to work more effectively and/or for longer periods of time. Although current labor laws in some countries may forbid pressuring employees to take such drugs, it might be necessary to draft new legislation that specifically addresses the use of “enhancement technologies” in other countries. Indeed, some healthcare workers must already accept what is arguably a type of enhancement in the form of flu vaccinations; some schools also require children to be vaccinated if they wish to attend. On the other hand, colleagues – rather than employers – might also pressure individuals to use “enhancers”. If the unofficial use of enhancers were to become popular in particular professions, some professionals might feel obligated to use them, as is already the case with respect to surgery in the following scenario. Surgery is a competitive profession. If some surgeons began using cognitive enhancers, they might become better at their jobs, leading other surgeons to use such cognitive enhancers. Furthermore, although employees should be protected from pressure to use performance-enhancing drugs, they might also face litigation if they make professional errors that might reasonably have been prevented by an "enhancer". For instance, if a "non-enhanced" surgeon made a mistake during an operation, he might be sued for not having taken a performance-enhancing drug that might have helped him prevent the error. In summary, new laws similar to those that presently regulate "doping" among athletes may be required to regulate both the employer-endorsed and the *de facto* use of enhancing drugs in the workplace.

The field of criminal law may also be interested in enhancing some criminals with "mood stabilizers". Just as some sex offenders are "chemically castrated", advanced "mood stabilizers" might be used to reduce the risk of recidivism among criminals. Similarly, so-called "morality pills" may soon become a reality. With such a drug, those convicted of crimes could choose to take pills that might help them make better moral choices. Alternatively, of course, they might be forced to take such pills as a condition of their release. Cognitive enhancers might even be used to improve certain aspects of criminals' cognition (in cases in which they have below-average cognitive levels). For instance, such enhancers might help them find work after release from prison or (more cynically) face their trial. Finally, some governments might consider giving "morality pills" to citizens who demonstrate a high risk of engaging in criminal behavior to reduce the risk that they might break the law in the future. In this case, we may wonder how such governments would determine what behaviors are considered to represent a potentially "high risk of criminality".

"Mechanical implants" may also raise new legal challenges. For example, *Google Glass* and other wearable devices incorporate technologies that can film videos, take pictures, read emails and/or surf the web. In a world in which people might easily and secretly record everything they see, new laws would be necessary to protect privacy and confidentiality.

International laws

Whereas societies probably want to legislate the use of technologies that might lead to human enhancement, the ramifications for international law are not immediately obvious. For instance, enhancing soldiers by means of technological modifications might have significant implications for the laws governing international conflicts and war crimes. When considered necessary, armies can essentially force their soldiers to take any technology or drug that may enhance their performance. For example, a new drug might enable soldiers to stay awake for 48 hours without tiring, and/or bionic implants might make them extraordinarily strong. If pharmaceutical and bionic interventions were to make the soldiers of rich nations such as the United States even more formidable adversaries, the military dominance of a few large nations would be enhanced to a staggering degree, reducing the ability of smaller, less advanced nations to defend themselves.

Sports constitute another arena of international regulations (also known as “soft laws”) affected by human enhancements. Most people are familiar with the Lance Armstrong scandal and the wider problems of doping in sports. For decades, the consensus has been that improving athletic performance using drugs is deeply wrong and unsportsmanlike. However, recent revelations concerning the extremely common and widespread use of doping substances in some sports has led some authors to call for doping substances to be permitted (Savulescu, Foddy, and Clayton 2004). Although these views remain in the minority, the regulations governing sports may have to change at some point in the future if doping in a particular sport becomes the norm rather than the exception. There is a parallel debate regarding the use of technologies that may enhance physical capacities in sport. For instance, the use of "bionic" body additions, such as Oscar Pistorius' running blades, has been widely discussed (Lewis 2011). It is typically regarded as fair for disabled athletes to use such artificial limbs, but in some cases – including that of Pistorius – these "replacement body parts" might actually perform better than normal biological human limbs.

Finally, it is possible that new international laws will have to be implemented to govern "enhancement tourism", in which citizens from a homeland in which the use of a given enhancing technology is forbidden might choose to travel to another country in which it is available. We can easily make a parallel with "fertility tourism", in which people seek access abroad to reproductive services that are forbidden in their own country. The prospect of some countries allowing many forms of human enhancement – whereas others are more prohibitive – also creates the ability for these countries to establish economic sectors based on developing technologies that offer human enhancements.

A related issue involves groups of countries such as the European Union. These unions of states might want to implement legislation on strategies regarding the use of enhancing technologies so that citizens of all member states continue to have the same rights and opportunities in the workplace, for instance. In other words, if enhancement in the workplace were permitted in some states but not in others, the rights of workers in permissive states might be eroded. Similarly, some countries might feel compelled to adopt a permissive attitude toward enhancement to remain competitive (Menuz, Roduit, and Hurlimann 2013).

Any future laws governing the enhancement of humans will be based on an ethical consensus regarding the key issues. The current consensus is that the three main areas of ethical concern are safety, coercion and fairness. The law must therefore prevent the use of unsafe technologies for purposes of enhancement, prevent people from being forced to use technologies to enhance themselves when they do not wish to do so, and prevent people from unfairly benefiting from the use of such technologies. Whether in the workplace, on a running track, or in the race to live to 200 years old, the wondrous potential of enhancement must be regulated by carefully drafted legislation.

References

Anderson, Ryan T. and Christopher Tollefsen. "Biotech Enhancement and Natural Law" *The New Atlantis*. Accessed September 18, 2014, http://www.thenewatlantis.com/publications/biotech-enhancement-and-natural-law.

Harris, John. 2007. *Enhancing Evolution: the Ethical Case for Making Better People*. Princeton, NJ: Princeton University Press.

Lamkin, Matt. "A Ban on Brain-Boosting Drugs Is Not the Answer." *Chronicle of Higher Education*. Accessed September 18, 2014, http://chronicle.com/article/A-Ban-on-Brain-Boosting-Drugs/126523/.

Lewis, Tim. "Is It Fair For 'Blade Runner' Oscar Pistorius to run in London Olympics?" *The Guardian*, July 31, 2011, http://www.theguardian.com/sport/2011/jul/31/oscar-pistorius-should-he-compete/.

Menuz, Vincent, Johann Roduit, and Thierry Hurlimann. “Améliorations humaines : libertés ou Obligations?” *Huffington Post France*. Accessed September 18, 2014, http://www.huffingtonpost.fr/vincent-menuz/technologie-amelioration-corps-humain_b_3055055.html.

Savulescu, Julian, Bennett Foddy, and Megan Clayton. 2004. “Why We Should Allow Performance Enhancing Drugs in Sport.” *British Journal of Sports Medicine* 38 (6): 666-70.

Shaw, David. 2014. “Neuroenhancing Public Health.” *Journal of Medical Ethics* 40 (6): 389-91.

Shaw, David. 2012. “Weeping and Wailing and Gnashing of Teeth: the Legal Fiction of Water Fluoridation.” *Medical Law International* 12 (1): 11-27.

Stern, Mark J. Accessed September 8, 2014. “You Are Already Enhanced.”. *Slate*. http://www.slate.com/articles/health_and_science/superman/2013/05/history_of_human_enhancement_how_plastic_surgery_birth_control_aspirin_ivf.html

Illustration 3 "Human enhancement and evolution" by N.Stepanova

Chapter 3: Human enhancement and evolution

José Aguilar-Rodríguez and Ali Rezaee Vahdati

"*Humankind is about to enter a new phase of evolution.*" – J. Craig Venter, *Life at the Speed of Light* (2013)

The biological sciences are evolving at an unprecedented pace. Following the discovery of DNA and the rise and spread of digital technology, the biosciences are experiencing spectacular advances that are expanding our comprehension of the living world and our ability to control it. Humankind is at the door of a new era of biological design, an era dominated by powerful technologies capable of improving not only the world in which we live but also our own bodies and minds. If such biotechnological interventions in or on human beings come to pass, we might finally be able to domesticate the process that has created us and that is continuously modifying us: *evolution*.

Evolution is sometimes defined as a change in the composition of the traits of a population over time. One of the causal mechanisms for most (but not all) of this change is *natural selection*. Natural selection is the process by which inheritable traits that favor survival and reproduction increase their prevalence in a population from one generation to another. In other words, traits that favor their individual carriers become more common in a population (positive selection), while deleterious traits become rarer (negative selection). Beginning with a given population, after many generations, natural selection may lead to the creation of subpopulations displaying different traits. Now, imagine that this natural selection process acts over millions of years: ultimately, traits between subpopulations might become so dissimilar that each subpopulation becomes "something" quite different. In other words, by means of natural selection, they diverge to such an extent that they can no longer interbreed, transforming them into new species. This process is called *speciation*. All living beings that inhabit the Earth descend from a form of life that lived more than 3.5 billion years ago: the "*last universal common ancestor*" (LUCA). Since LUCA, life has unceasingly branched out through speciation to finally create all the species that lived and that are currently living on Earth.

As is true of any other biological species, we humans are also the product of evolution through natural selection. However, in our case, human culture has also played a crucial role during our own evolutionary process. The advent of culture has sheltered us from the harsh environment faced by our prehistoric ancestors, mitigating many environmental pressures that molded our traits in the past. However, the advent of culture has also created subtle selective forces that have participated in the forging of modern human beings, such as "lactase persistence", which is the ability to digest lactose into adulthood. Lactase is an enzyme that allows us to break down lactose (a sugar present in milk). Active during childhood, lactase is normally switched off as children grow older. However, the persistence of this enzyme during adulthood has become a common trait in certain human populations. This persistency correlates with the domestication of dairy animals over the last ten thousand years. In other words, the increase in the frequency of individuals showing lactase persistence constitutes an adaptation driven by the consumption of non-human milk beyond infancy. This trait is highly beneficial for populations with diets containing high levels of dairy products and clearly illustrates how human culture can influence the presence – and/or absence – of certain human characteristics.

Although human beings have been forged by evolution through natural selection (among others causes), we may wonder whether we are continuing to evolve. Some commentators – such as the geneticist Steve Jones, the naturalist Sir David Attenborough and the late paleontologist Stephen Jay Gould – have expressed doubt about such contemporary processes of evolution (Gould 2000; Bellutz 2008; Furness 2013). They claim that human beings do not actually evolve anymore because modern medicine has considerably reduced the tragic toll of negative selection by correcting the deleterious effect that some traits may have on individuals.

Medical interventions have been extremely successful in improving human living conditions, even for those individuals carrying traits that may cause serious morphological, behavioral and physiological problems (e.g., hemophilia and diabetes, among others). However, it would be an oversimplification to assert that improved living conditions have stopped the evolution of the human species. Although many societies have reduced mortality rates by means of advances in medicine and social policies, many developing countries in which fatal diseases (e.g., malaria) remain and impose strong selective pressures. As a consequence, at least in these countries – which account for the majority of the global human population – natural selection continues to select traits that confer survival and reproductive advantages.

In addition, several studies have characterized natural selection in human populations from industrialized countries, suggesting that it remains in effect. For instance, the "Framingham Heart Study" – an ongoing medical health survey on all Framingham inhabitants since 1948 (Massachusetts, USA) – has consistently measured changes in citizens' so-called health markers such as blood pressure, cholesterol, blood sugar levels and body weight. Surprisingly, scientists have found certain correlations between health markers and the number of descendants. For example, women with lower blood pressure and cholesterol levels tend to have more children. These results might support the proposition that human evolution has not ground to a halt in contemporary populations and that we humans remain under the tight control of the "natural forces" that have made us.

Moreover, there is another side to the story. Medical progress and progressive social policies have substantially reduced the efficiency of negative selection (i.e., the decrease in traits that are not favorable in a given environment). Nevertheless, authors such as James Crow (1997) and Bill Hamilton (2002)– both evolutionary biologists – believed that this achievement of our industrialized societies does not occur without costs because it leads to the long-term accumulation of "deleterious" traits. Normally, natural selection ensures that the recurring input of deleterious traits in each generation is balanced by the selective elimination of such traits. According to these authors, by reducing the latter, medical interventions favor the steady accumulation of such deleterious traits in individuals who live in industrialized countries. The immediate effect of such deleterious traits can be minimized – or mitigated – by medical interventions. However, these authors believe that this situation will be unsustainable in the long-term and that it might become problematic for the long-term future of the human species.

In this sense, authors such as Alexey Kondrashov (2012a, 2012b) and Michael Lynch (2010), both geneticists, share a rather stark vision of the future of humanity. They have both recently suggested that the residents of developed countries are accumulating deleterious traits because they are less subject to negative selection. According to their arguments, it is probably the first time in human history that this accumulation is occurring at such a high rate. Lynch believes that future human beings in wealthy countries will likely be *"(...) different in just two or three centuries, with significant incapacitation at the morphological, physiological, and neurobiological levels"* (Lynch 2010, 966).

One may wonder whether these authors are harbingers of doom or whether they may be – at least partially – correct in their assessments. Experimental evidence supports their claim that accumulated deleterious traits can affect a population quickly and detrimentally. For instance, when fruit flies – a commonly used animal in experimental biology – are bred in conditions of relaxed selection, they display a rapid accumulation of deleterious traits and soon exhibit a decline in their ability to survive and reproduce. Another example is "intracytoplasmic sperm injection" (ICSI), an *in vitro* fertilization technique that is frequently proposed for men who display few or no spermatozoids in their semen. A single sperm cell can be collected and artificially injected into a mature egg, thereby forming an embryo. The newly created embryo is then transplanted into a woman's uterus, in which it will continue its development through the end of gestation. However, a caveat of this technique is that boys conceived through ICSI can inherit their father's severe sperm problems, making them infertile as well, which clearly indicates how deleterious traits that would normally have been removed from human population can persist over generations due to medical intervention.

A crucial question emerges here: will we be able to find solutions for eliminating – or at least limiting – the unwanted effects related to the accumulation of deleterious traits in human populations? We may hope that, in the near future, our scientific and technological abilities will be powerful enough to diagnose, repair, or – at the very least – limit the effect of deleterious traits. After all, sterile boys conceived through ICSI could use the very same technique to overcome their sterility. In that sense, the advent of CRISP/Cas9 is promising. This is a rapidly advancing technique that endows scientists with the ability to easily alter the genomes of living cells – including germ line cells, i.e., sperm and egg cells. Alterations in these cells are particularly important for evolution because changes in their DNA are inheritable. This technique has previously been used to edit the DNA from fertilized eggs in monkeys.

Moreover, such a technology, which is able to reverse detrimental traits, might also be used to introduce changes to express "desirable" traits, allowing individuals to have greater control over their biological destiny. Such "improvements" will likely be based on the use of combined advances of, among others, biotechnology, robotics and nanotechnology. Biological bodies could therefore become a combination of organic and artificial parts. Modified individuals may live longer, show increased cognition, be physically stronger and be better looking compared with unmodified people.

However, the technological challenges required to modify human beings using biotechnology, including by means of CRISP/Cas9, will not be small. The main problem is that the effect of an introduced change can vary substantially from person to person – and from environment to environment. This phenomenon will make it practically impossible to accurately predict the effect of most modifications, at least in the near future. Moreover, the improvement of a trait can be the cause of unwanted deficits in related traits. For example, individuals with eidetic/photographic memory typically also have synesthesia. The stimulation of one of the five senses leads to an automatic reaction in another, i.e., hearing a particular sound triggers seeing a specific color. Because of these problems, the modification of human beings in the near future is more likely to originate from the fields of robotics, nanotechnology and pharmacology.

Some thinkers have postulated that radical technological interventions in our biology may transform us into "something different" from what we are. In other words, they believe that large-scale application of technology in or on human beings might make them evolve into "something else", a "new species" of hominids. Is it plausible? To answer this question, we first must understand how *Homo sapiens* – the humans we are now – appeared on Earth. We humans are the result of millions of years of evolution. Fossil records indicate that our first hominid ancestors lived approximately seven millions years ago in Africa. These first hominids were quite different from us and looked more like apes. We may wonder what made them evolve into the highly intelligent species that we are.

There are various compelling theories that address this question. One theory is perhaps more convincing than the others. During the nineteenth century, Charles Darwin – the first person on Earth to coherently propose that species have evolved through natural selection – thought that bipedalism set our ancestors onto the path of becoming what we are now. By releasing their hands from locomotion, these primitive humans could use them as tools. According to Darwin, *"Man could not have attained his present dominant position in the world without the use of his hands, which are so admirably adapted to the act of obedience of his will"* (Darwin 1871, 135).

In addition, the taming of fire is arguably considered one of the pivotal events in human evolution. Cooking helps us digest food more rapidly and efficiently. Such a reduction in the time spent feeding and digesting led these primitive humans to invest more time and energy resources in new activities. It is also believed that it helped humans allocate more energy for thinking and resolving day-to-day problems. The act of thinking is energy consuming. Whereas the modern human brain represents approximately 2.5% of our body weight, it consumes approximately 20% of the body's total energy budget. Therefore, the energy that is saved by the shorter period of time we require to digest our food can be redirected for brain activity, which may have had an impact on the improvement of our intellect. Therefore, cooking by fire might be another example of how technological advances have modified our biology.

Furthermore, approximately 2.5 million years ago, a shift in the evolution of hominids occurred. At that time, Africa experienced unusual climate instability that consisted of sequential changes between dry and rainy climates. These climate changes resulted in the extinction of many species and imposed new and strong selective pressures on the hominids, which were forced to adapt to survive. Those who developed more sophisticated hunting strategies (i.e., weapons) survived and had descendants.

Roughly knowing how *Homo sapiens* appeared, we may now explore whether the large-scale application of technology in or on human beings, together with substantial socioeconomic differences, might make them evolve into a "new species" of hominids. Many science-fiction writers have speculated about a possible future speciation for humanity. For instance, in *The Time Machine* (1895), H.G. Wells imagined humans evolving into two different and opposing species: "*Elois*" and "*Morlocks*". The first are beautiful frugivorous creatures who are, by nature, childish, stupid and weak. They are the descendants of wealthy humans who lived comfortably in a utopian Earth as the result of the systematic application of technology. The second species are hideous albino creatures that prey on the "*Elois*" and live in underground and mechanized cities. They are the descendants of the poor working classes. Wells' imagination notwithstanding, given the time it has taken to "make" the humans who we are, it is highly improbable that technological modifications of our biology will soon lead to speciation. Moreover, speciation implies the creation of an initially homogenous subpopulation, i.e., populations that share identical traits. In addition to the technological modifications that may be necessary to repair deleterious traits, individuals may wish to have traits according to their personal preferences, therefore leading to more diversity than unity between individuals.

Combating the adverse effects of deleterious traits – and enhancing other traits – will be costly. Will this ability be restricted to a rich minority? Or will it instead be accessible to anybody who may wish to use it? Should we worry about a schism between the enhanced rich and the unenhanced poor, similar to that between the "*Elois*" and the "*Morlocks*"? Considering the current social and economic differences between individuals, the possibility of emphasizing some of our traits – such as cognitive capacities or lifespan, for instance – will probably not be available to all. Many people in today's world do not have the luxury of having enough to eat, whereas others live under harsh dictatorships that may not allow people access to the relevant technology. Industrialized countries struggle with unemployment and income inequality (for example, the 2011 census data (www.census.gov) showed that half of the U.S population lives in poverty or near poverty). We believe that crucial socio-ethical issues related to human "enhanced evolution" would mainly concern the justice aspect of its application.

We have evolved from other animals, but evolution is not over for us. Evolutionary changes continue and will continue to occur in human populations. Some of these changes are the product of cultural and technological advances, but we do not have any control over them at present. We are changing in ways that we may not consider desirable. Nonetheless, it is possible that, in the near future, we may achieve greater control over our own evolution with the help of technology. It may be possible that we will be able not only to stop unwanted changes but also to introduce desirable changes. Technology will undoubtedly accelerate human evolution. What is more doubtful is the extent to which we will be able to control such a process and to select the evolutionary trajectories we may take.

References

Bellutz, Julia. 2008. “Leading Geneticists Steve Jones Says Human Evolution is Over”. *The Times*, October 7.

Crow, James F. 1997. “The High Spontaneous Mutation Rate: Is It a Health Risk?” *Proceedings of the National Academy of Sciences* 94 (16): 8380-6.

Darwin, Charles. 1871. *The Descent of Man, and Selection in Relation to Sex*. London: John Murray.

Furness, Hannah. 2013. “Sir David Attenborough: Humans Have Stopped Evolving.” *The Telegraph,* September 10.

Gould, Stephen J. 2000. “The Spice of Life: An Interview with Stephen Jay Gould.” *Leader To Leader* 15:19–28.

Hamilton, William D. 2002. *Narrow Roads of Gene Land Volume 2*: *Evolution of Sex*. Oxford: Oxford University Press.

Kondrashov, Alexey. 2012a. “James Crow (1916–2012).” *Nature* 481 (7382): 444.

Kondrashov, Alexey. 2012b. “Genetics: the Rate of Human Mutation.” *Nature* 488 (7412): 467-8.

Lynch, Michael. 2010. “Rate, Molecular Spectrum, and Consequences of Human Mutation.” *Proceedings of the National Academy of Sciences* 107 (3): 961–8.

Venter, Craig. 2013. *Life at the Speed of Light: From the Double Helix to the Dawn of Digital Life*. New York: Viking Adult.

Wells, H G. 1895. *The Time Machine*. London: Penguin Classics.

Illustration 4 "If doping is wrong, why do we love Popeye? Let’s topple talentocracy" by N. Stepanova

Chapter 4: If doping is wrong, why do we love Popeye? Let's topple talentocracy

Pieter Bonte

"Talent is meritless birth privilege. Doping, in contrast, can emancipate those less lucky at birth. To celebrate athletes born with 'noble blood' smacks of aristocracy. Let's stop protecting their privilege, let's stop discriminating against dopers."

It's the First Olympics, and "BLAM!", Hercules uppercuts Popeye straight to the moon. Looks like K.O. for our sailor man. Luckily, the goddess of Spinachio takes pity. She slips some green goo down his pipe – and what a boost! Muscles popping up all over his body, Popeye rockets back to Athens and knocks Hercules out cold. In this 1951 cartoon, the crowd roars in jubilation. Olive Oil swoons: *Popeye, my hero!*

But how much of a hero is Popeye (or is it *Dopeye*?) in the eyes of the World Anti-Doping Agency? Sports should be about effort and fair play, right? Now look at Dopeye. His muscles grew without any effort: the superspinach did it for him. Plus Spinachio only gave the goo to Popeye: poor Hercules had none, he didn't even know about it. Even if Hercules could have doped himself with superspinach too, some would think that the competition would *still* be unfair. As ex-Tour de France cyclist Jonathan Vaughters writes: "*To argue that if everyone is doping and using the same dope, then it's fair, is bunk. Different drugs affect different metabolisms in different ways and some people will always benefit more from certain drugs than others. This is why doping must end, or we will not get to see who is truly the best*" (Vaughters 2004).

So on the one hand, our culture is filled with cartoons celebrating magic boosts, effortless and unfair. On the other hand, 'doping sinners' are being hunted down and shamed like witches.

Here we have a deep contradiction running through our moral culture. How can we resolve this? Here are two basic options:

- *Plan A*: We rewrite our children's stories, in which we promote, through the behavior of heroes such as Popeye, Asterix and countless others, taking enhancing substances to gain strength, cunning and other winning qualities.

- *Plan B*: Alternatively, we bring the sports world in line with the morality we impress upon our children: if you can get your hands on a foodstuff, potion, genetic manipulation (think of Spiderman) or some type of enhancement technique, and it is sufficiently safe, then do it, even if it requires only minimal effort and is not equally available to others.

- My sympathies go to Plan B, resoundingly. Long live our loveable doping heroes, down with zero-tolerance anti-doping. Here's why.

What is doping?

What does "doping" mean, exactly? The World Anti-Doping Agency considers any substance or method to be doping if it (1) might enhance performance, (2) might pose a health risk to the user, and/or (3) offends WADA's "Olympic spirit of sport" (WADA 2015: 30). Only two of these three criteria must be met. This means that when a substance enhances performance and offends this spirit, it is doping, even if a substance or method is healthy.

So what is this "Olympic spirit" then? According to the World Anti-Doping Code, *"the essence of Olympism [is] the pursuit of human excellence through the dedicated perfection of each* *person's natural talents."* (World Anti-Doping Agency 2015: 14). I don't get this. Why must sports be categorically *talent-based?* How fair is *that* toward those who were born with less talent? The moral beauty of cartoons such as Popeye is that through doping, the naturally weaker, less talented Popeye can finally win against natural-born strongmen like Hercules and Bluto. This is why I still cheer for Popeye, even if he is exposed as a Dopeye. Maxwell Gladwell, author of the bestselling *David and Goliath: Underdogs, Misfits and the Art of Battling Giants* shares this sentiment. Doping can be *"the means by which pudgy underdogs could compete with natural wonders"* (Gladwell 2013). Nevertheless, anti-doping is still frequently defended in the following zero-tolerance manner: (a) doping is *intrinsically wrong*, i.e., wrong under any and all conceivable conditions; (b) morally, *nobody* should ever be allowed to dope; and (c) doping should be universally *forbidden* – certainly by the internal regulation of sports associations, and often also by (criminal) law. (Murphy 2013)

Luckily, in response to a growing group of critics (see Tännsjö 2000; Savulescu, Foddy, and Clayton 2004; Mehlman 2009), less extreme policies are being considered within the ranks of WADA officials. They acknowledge the basic right of individuals in liberal democracies to exercise bodily freedom even at great risk (Murray and Murray 2011; see also Brownsword 2012). Ironically, it is precisely the practice of sport that frequently sets the very low standards of health that we can paternalistically impose: we allow individuals and groups to expose themselves to great, even lethal risks such as cycling down sharply twisting Alpine roads, dangling on treacherous mountains in the freezing cold, racing neck-and-neck in ultrafast cars, and playing high-impact collision sports, such as rugby, football, basketball, wrestling and boxing. Clearly, many doping practices will be less risky than many of the sporting activities we currently allow people to practice. Consequently, anti-doping zero-tolerance should be curtailed in two ways. First, only doping that has been proven to have or that reasonably should be presumed to have a *very excessive risk profile* can be legally forbidden. Second, other forms of doping must be *legally* permitted and can only be forbidden within those private associations that chose to ban them.

However, that is only an argument for *tolerance*, *permissiveness* and *indifference.* I want to advance a much deeper, more disturbing set of arguments. I have addressed moral, existential, religious and aesthetic arguments for doping elsewhere previously (Bonte 2012). In this article, I want to discuss *fairness* and *non-discrimination.* I argue that anti-doping zero-tolerance might be a form of undue discrimination *even in a private sports association*. For instance, intolerance toward the medically supervised intake of Erythropoeitin (EPO) – a popular doping agent in cycling – may be illegitimately discriminatory.

Talentocracy: the love of hereditary privilege

What is talent? Here is how Sigmund Loland and Hans Hoppeler characterize it:

> *Genetic factors are the predispositions for developing the relevant phenotypes for good performances in a sport[.] A person with good predisposition is usually characterized as a 'talent.' Talent in this sense is distributed in the so-called 'natural lottery' and based on inheritance. (Loland and Hoppeler 2012: 3)*

I note four elements. Talent is (1) *unmerited*, the result of a lucky draw in the natural lottery; (2) *effort-reducing,* making certain types of performance easier relative to those with lesser or no such talent; (3) *biochemical,* made up of biochemical substrates, such as a naturally elevated amount of red blood cells, which is what others need EPO for; and (4) *genetic*, innate and transferrable to future generations.

Examined in this light, talent can be disparaged in the very same way many people disparage doping: it is an unmerited, effort-reducing, biochemical advantage. The only differences seem to be that talent is something you are born with.

Certainly, if you stumble on some talent that you were born with, it is yours to keep, and nobody has the right to, say, load weights on your ankles if you were born faster than others or throw a veil over your face if you were born more beautiful than others. However, it is as equally certain that, to use Barack Obama's famous phrase, *"you didn't build that".* You *as a person* do not deserve praise simply because you were born with greater "biocapital" than others, just as we should not think more of somebody with the good fortune of being born into a mansion and a greater bank account.

Suppose that you *were not* born with great biocapital. Can you undergo some enhancement procedure to endow yourself with similar or even superior bodily capabilities compared with those who were born talented? Can others impose some ban on you that says "no", it is absolutely forbidden, you will be punished for it and you are a fraud and a freak for doing so? From this perspective, the categorical anti-doping morality seems to fly in the face of this basic moral right to emancipate yourself from natural incapacitation.

Why, then, do anti-doping absolutists nevertheless push for a categorical internal ban on doping? Why do they mobilize a surveillance and police force to control athletes for biological orthodoxy, and stigmatize, with religious fervor, those individuals caught meddling in this form of modern witchcraft as "doping *sinners"?* One plausible answer is that they would do so out of adoration for what Thomas Jefferson called "nature's aristocracy*"* (Cappon 1959, Ch. 15, doc. 61). By setting up *enforced endowment-based* tests of certain qualities, we can see emerge from the huddled masses those who *innately* hold these qualities to a superior degree. This 'true, natural aristocracy' can then be publicly celebrated as those who are "truly the best". Numerical rankings, offering big shiny medals for all to see: that would do the job perfectly.

Such a "spirit of sport" would literally be as *aristocratic* as ever: a celebration of those with "nobler blood" – those "of superior stock", to use the eugenicist phrase. It would be a true *talentocracy:* a hardline brand of aristocratic thought that has wizened to the fact that hereditary superiority does not follow superficial familial, class or caste affiliations. A better understanding of the natural world has now revealed that innate superiorities can be found throughout the entire populace. Therefore, if you want to sift through the aristocracy and install the superior beings in their rightful thrones, then you should invest substantial effort in providing everyone with "equal opportunity" of development and participation.

Micheal Dunlop Young, the satirical inventor of the phrase "meritocracy", wrote convincingly how, under the sheepskin guise of meritocracy, many supposedly "liberal" and even "socialist" activists in fact advance an agenda of hereditary privilege – a talentocratic ordering of society. (Young 1958) The desire in sports to discover and celebrate, in the words of Vaughters, "*who is truly the best*" – similar to the desire in beauty pageants to do the same with who is "truly" and "naturally" most beautiful – may be the most glaring example of such "scientifically enlightened" aristocratic thinking.

Zero-tolerance anti-doping as discrimination

Having exposed the danger of talentocracy, let me now attempt to nail down the argument announced above: that anti-doping absolutism is illegitimately discriminatory.

The basic principle of non-discrimination teaches that all relevantly similar things should be given equal treatment. To return to Dopeye and Hercules: both are muscular, both are good at Olympic sport(s), both are willing to compete and both are confident that they might win; thus, a test of strength between the two would possess "*the sweet tension of uncertainty of outcome*", a central component in a meaningful competitive game, according to sports philosopher Warren Fraleigh (1984). They differ only in *how* they obtained their muscles. Is this a *relevant* difference, allowing us to deny Dopeye access to the Olympics or to disqualify him when we discover that he is hopped up on superspinach?

More broadly, are we discriminating when we ban participants from entering the playing field when they obtained their relevant ability to play via some complex cocktail of talent+training+effort+doping yet allow those who obtained their relevant ability to play via another complex cocktail involving all manner of talent+training+effort but without doping? I think we often are. Specifically, we discriminate when, after closer inspection, we find that the doper did not violate the so-called *constitutive rules* of the game: rules that, if broken, cause you *to no longer be playing the same game*. Let us pitch some arguments to see whether doping actually causes one to *no longer play the same game.*

Strike One: rules of in-game structure

What is a game? A quick and classic definition is given by Bernard Suits: "*the voluntary overcoming of unnecessary obstacles.*" (Suits 1978) Thus, a game requires obstacles that (a) actually are *obstacles*, that is, that provide a challenge, but (b) a challenge that can, in interesting ways, be *overcome.* The implication is that every game is designed *for a certain type of player*. For such players, you must hit a sweet spot of providing the right amount and the right type of challenge.

Take a basketball court. The dimensions of the court, the height of the hoops, the size of the balls, the duration of the game – these are all specifically calibrated to provide specific challenges to persons with a healthy human constitution. When skilled humans play the game, it can be a beautiful sight to behold. A game such as *Space Jam* (Pytka 1996), however, where 3-meter tall monsters compete against tiny Porky Pigs and Tweety Birds would actually make no sense at all: these characters simply do not fit the structural dimensions and conventions of our fit-to-human-size basketball courts and rulebooks.

Now, is the absolutist anti-doping rule also such a constitutive, structural game rule? No, it is not. It is true that, in *some* fanciful cases, doping would create excessively different and disproportionate types of players, such as when an extreme growth hormone created players who were three meters tall. However, even then, would this phenomenon pose a fundamental problem? No. It would only pose a brief organizational problem, a problem that is not peculiar to doping and that has been solved a million times before. New forms of training, in-game strategizing, improvement in equipment, etc., can equally confront us with problems such as some players who begin to "overshoot the mark". We solve these problems in two general ways. Solution one: similar to how the size of football goals or the height of basketball goals increases from children to adult players, you raise the bar, and in so doing, you create *a new category of players* who play the same game, only now with a higher bar or goal to suit their size. Solution two: you add rules about *handicaps and/or advantages* to the game. For instance, you provide players of a shorter stature a head start or a bonus point. Both solutions can be applied to "prosthesis dopers", such as Oscar Pistorius, who run not on lower legs not made of flesh-and-blood but of fiberglass legs, or to "surgical dopers", such as Tiger Woods, who use Lasik eye surgery to obtain vision that is better than 20/20. Either you make them play in different categories or else you let them remain but add a handicap rule to compensate the unfair advantage they have over differently legged or eyed competitors. We constantly negotiate such classifications and equilibrations in a satisfactory manner. The problem is not *moral*; it is simply organizational.

Strike Two: rules of in-game psychodynamics

Ultimately, the obstacles in our games are not merely of a physical or strategic nature. The challenge of the game will always be *psychological* as well – a test of character, cunning, willpower and the like. Does doping pose a categorical danger to the maintenance of such a meaningful psychological dimension? No, it does not.

First, some think doping is intolerable because it makes things too effortless. In the case of EPO, this notion is utterly mistaken. For instance, Tyler Hamilton (Lance Armstrong's wingman for many years) writes the following about EPO: *"EPO granted the ability to suffer more; to push yourself farther and harder than you'd ever imagined, in both training and racing. It rewarded precisely what I was good at: having a great work ethic, pushing myself to the limit and past it"* (Hamilton and Doyle 2013, 58). It is also contradictory: the use of *talent* and *natural ease* in performance would then have to be intolerable as well. What is more, certain forms of doping actually *increase the need for willpower:* this is what anabolic steroids do. Steroids are *willpower- and effort-enhancing doping:* they reduce recuperation time, which means that, if you have the willpower to keep exercise all the time, steroids allow you to do so. They do not simply grow muscle *for* you. The documentary *Bigger Stronger Faster* vividly paints that picture for you (Bell 2008). Second, if some type of doping *would* make some feat too easy, that is not a problem. Do what Hamilton and countless other athletes like him do: *raise the bar.* The same psychological intensity, if not more, will be required to overcome that new, more difficult obstacle.

Strike Three: rules of preparation

Constitutive game rules can extend beyond what occurs during game time. They can also regulate how you prepare and practice before the game begins. Indeed, the entire point of game time can be to test how different players have made the most of the pre-game period of preparation, during which everyone also had to respect certain rules. One such rule of preparation may be that nobody is allowed to dope.

In this regard, however, strictly talent-based sports seem more problematic than doping. Demanding that only talent and traditional food will be the tolerated biochemical substrates of performance cannot be a sensible constitutive rule. For one, it is too crude. What *is* sensible would be, for instance, to demand that all competitors must not exceed a specific range of capacity for maximum oxygen uptake. Moreover, to favor one unmerited, effortless, biochemical substrate of the ability to play (talent) over another (doping) would be senseless discrimination.

To use a contemporary example, it may certainly make sense to restrict the hematocrit level of all Tour de France cyclists to 50 and to deny access to all riders with higher levels, as former UCI chairman Hein Verbruggen once proposed. Verbruggen was willing to allow any method to achieve this mark of 50, doping included. Riding a Tour de France with a higher hematocrit level was nonsensical to him because it would be too dangerous. However, you can make similar decisions to cap a certain parameter at some point not only for health reasons but also because the obstacles would lose too much of their challenge beyond a certain point or, inversely, might become excessively challenging (as in the case of too-tall monsters and too-tiny Tweety Birds playing basketball against one another on a human-sized court).

People were outraged at Verbruggen's proposal, arguing that it was akin to saying that stealing is wrong but everyone can steal until they have €50 in their pocket. (Hamilton and Doyle

2013, 42) However, for me, this outrage may serve as a classic case of (unwitting) talentocratic thinking. The correct analogy here is this: some people are *born with* €50 on their bank account, whereas other people *make choices* (exercise, develop strategy, dope, etc.) to obtain €50 on their bank account. Surely, people should be allowed to catch up with the people who were simply born rich?

When the dust settles, there is no great drama here. Strike one, strike two, strike three: anti-doping zero-tolerance is out and did not hit a single argument.

Down With Talentocracy

Doping is not inherently unfair. Talent is. Policies that shield the well-born from competition by dopers create a glaringly unfair talentocracy. Michael Dunlop Young said "Down With Meritocracy" (2001). I would like to specify: down with *talentocracy*, up with opportunity. My proposal is in fact quite basic. This makes it compatible with all sorts of libertarian, liberal or socialist thought. My case has simply been this: stop discriminating against the naturally worse-off. Hurrah for Popeye standing up to Hercules, hurrah for Dopeye standing up to the talentocrats. Our doping cartoons tell the right story: stop glorifying the 'true, natural aristocracy', stop discriminating against those who responsibly enrich their bodies with biotech. If we can get our morals and politics halfway right, then biotechnological enhancement will be emancipation.

References

Bell, Chris. 2008. *Bigger, Stronger, Faster. Is It Still Cheating If Everyone Is Doing It?* (Documentary). New York/Austin: Magnolia Home Entertainment.

Bonte, Pieter. 2013. “Dignified Doping: Truly Unthinkable? An Existentialist Critique of ‘Talentocracy’ in Sports.” In *Athletic Enhancement, Human Nature and Ethics*, ed. Jan Tolleneer, Sigrid Sterckx, and Pieter Bonte, 59–86. Dordrecht, The Netherlands: Springer Verlag.

Brownsword, Roger. 2013. “A Simple Regulatory Principle for Performance-Enhancing Technologies: Too Good to Be True?” In *Athletic Enhancement, Human Nature and Ethics*, ed. Jan Tolleneer, Sigrid Sterckx, and Pieter Bonte, 291-310. Dordrecht, The Netherlands: Springer Verlag.

Cappon, Lester J. 1959. *The Adams-Jefferson Letters: The Complete Correspondence between Thomas Jefferson and Abigail and John Adams*. Edited by Lester J. Cappon. 2 vols. Chapel Hill: University of North Carolina Press for the Institute of Early American History and Culture, Williamsburg, Virginia. http://press-pubs.uchicago.edu/founders/print_documents/v1ch15s61.html.

Fraleigh, Warren P. 1984. *Right Actions in Sport: Ethics for Contestants*. Champaign: Human Kinetics Publishers.

Gladwell, Malcolm. 2013. “Man and Superman. In Athletic Competitions, What Qualifies as a Sporting Chance?” *The New Yorker,* September 9.

Hamilton, Tyler and Daniel Coyle. 2013. *The Secret Race: Inside the Hidden World of the Tour De France: Doping, Cover-Ups, and Winning at All Costs*. London: Bantam Press.

Loland, Sigmund and Hans Hoppeler. 2012. “Justifying Anti-Doping. The Fair Opportunity Principle and the Biology of Performance Enhancement.” *European Journal of Sports Science* 12 (4): 347-353.

Mehlman, Maxwell J. 2009. *The Price of Perfection. Individualism and Society in the Era of Biomedical Enhancement*. Baltimore: Johns Hopkins University Press.

Murphy, Jaan. 2013. “Where in the World Is Doping a Crime?” *FlagPost Blog. Information and Research from the Parliamentary Library of Australia*, April 24. http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/FlagPost/2013/April/Where_in_the_world_is_doping_a_crime_doping_in_sports_pt_6.

Murray, Thomas H. and Peter Murray. 2011. “Rawls, Sports, and Liberal Legitimacy”. In *The Ideal of Nature*, ed. Gregory E. Kaebnick, 179-200. Baltimore, MD: Johns Hopkins University Press.

Pytka, Joe. 1996. “Space Jam.” (film). Warner Brothers.

Savulescu, Julian, Bennett Foddy, and Megan Clayton. 2004. “Why We Should Allow Performance Enhancing Drugs in Sport.” *British Journal of Sports Medicine* 38 (6): 666–70.

Suits, Bernard. 1978. *The Grasshopper: Games, Life and Utopia*. Edinburgh: Scottish: Academic Press.

Tännsjö, Torbjörn and Claudio Tamburrini. 2000. “Is It fascistoid to Admire Sports Heroes?.” In *Values in Sport: Elitism, Nationalism, Gender Equality, and the Scientific Manufacturing of Winners*, ed Tännsjö Torbjörn and Claudio Tamburinni. London: Kluwer Academic Publishers.

Vaughters, Jonathan. 2004. “What Would You Do?” *Cycling Weekly,* October 3, 32–3.

World Anti-Doping Agency. 2009. “World Anti-Doping Code.” http://www.wada-ama.org/World-Anti-Doping-Program/Sports-and-Anti-Doping-Organizations/The-Code/.

Young, Michael. 1958. *The Rise of the Meritocracy*. London: Thames and Hudson.

Young, Michael. 2001. “Down with Meritocracy.” *The Guardian,* June 28.

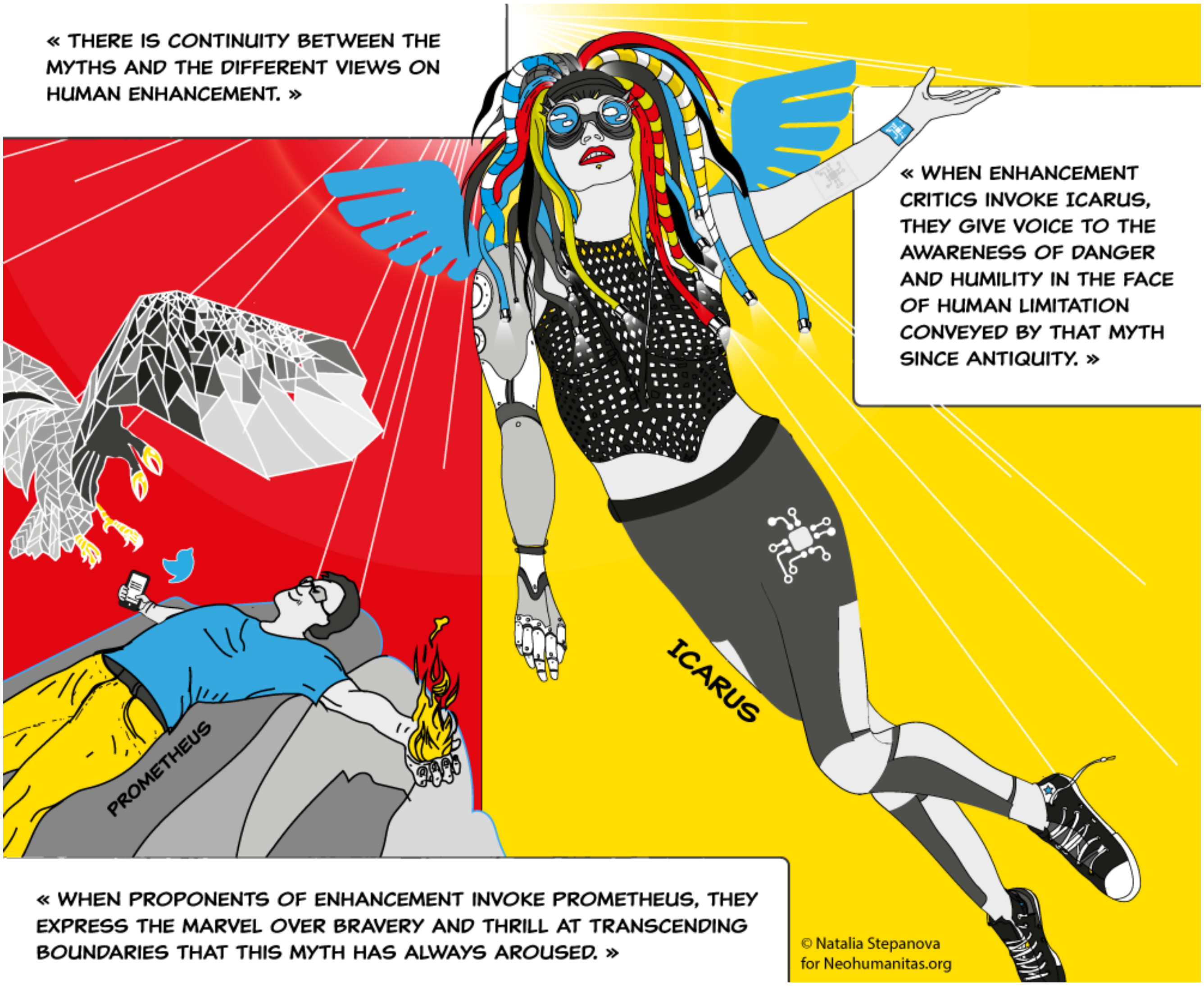


Illustration 5 "Heracles or Icarus: Mythological References in the Human Enhancement Debate" by N.Stepanova

Chapter 5: Heracles or Icarus: Mythological References in the Human Enhancement Debate

Trijsje Franssen and Erik Malmqvist

“Let us be the New Prometheans. Let us unite in our commitment to boldly go where none have gone before in search of the knowledge by which to transcend the limitations of the human condition” (Young 2006).

“In his moment of triumph, Promethean man will become also a contented cow” (Kass 2002).

An intense debate currently rages over the possibility and desirability of radically altering human characteristics by means of technologies such as *in vitro* fertilization (IVF), cloning, genetic engineering, information technologies, nanotechnologies and artificial intelligence. Some vigorously advocate using such technologies not only to overcome disease and disability but also to “enhance” our capabilities and expand our cognitive and physical powers far beyond the normal range – and perhaps even to pursue immortality. Others passionately argue against such “human enhancement” and object that seeking to cross the limits of human “nature” would threaten human dignity, erode the meaning of valuable social practices or even of life itself, or result in other disastrous consequences.

Nothing seems more novel than this debate launched as the result of the most recently developed technologies. It is therefore striking that this same debate is frequently riddled with ancient mythological references. Both proponents and opponents of human enhancement refer to these characters in support of their arguments. This chapter explores the significance of these references. We show how both sides of the "enhancement debate"[2] invoke mythological figures and explain how these figures relate to their views. We end by suggesting that Greek mythology influences the manner in which we think about enhancement more deeply than is commonly recognized and that acknowledging this influence might help cool down the frequently overheated debate.

Mythological characters invoked by proponents of enhancement

Proponents of human enhancement are optimistic about the prospects of using newly developed technologies to overcome our current limitations. Some advocate for considerably expanding the human life span. For instance, David Gems – a scientist working on the biological process of aging – argues that aging should not be considered a "normal process" but a "*special form of disease*", at least in human beings (Gems 2011, 109). Gems believes that this redefinition may help us more efficiently work on human age-related diseases. Currently, each illness on the broad spectrum of age-related diseases is studied independently. To emphasize the lack of effectiveness that this single approach has for patients' health, Gems use the metaphor of the hydra that Heracles must kill. "*For clinicians, the challenge of treating illnesses in the elderly must at times seem like Heracles' triumphs of combating the multi-headed Hydra. Each time one head was severed, two more would sprout in its place*" (110). Although Heracles' task seemed impossible at the outset, he finally succeeded by burning the Hydra's neck stumps after each decapitation. Gems suggests an even more radical approach to fighting ill health in the elderly: "*In principle, a more effective way to tackle human age-related illness would be to intervene in ageing itself.*

[2] In this paper, "enhancement" refers to *human* enhancement, and therefore, we use "human enhancement" and "enhancement" interchangeably.

Deceleration of ageing provides protection against the full spectrum of diseases of ageing thereby assuring late-life health, and strikes at the heart of the Hydra of ageing" (*ibid*.).

For Gems, the Hydra represents aging and death, two evils that should be resisted and/or overcome. There is one important aspect of Heracles' tale that seems particularly relevant to his argument that Gems does not explicitly discuss. The Hydra was the guardian of the world of death. Therefore, by analogy, killing the Hydra of aging may offer us some semblance of control over death. In other words, fighting aging may reduce age-related illnesses, which in turn may delay death and truly increase the human lifespan. Although Gems acknowledges that some may feel uncomfortable with it, "*the only serious option is to adapt as best as we can to a future involving ever greater extension of lifespan*" (111). He is confident that we will have the Heraclean courage and capacity to overcome our current human condition and believes that we have a responsibility to do so.

Gerontologist Aubrey de Grey is another firm supporter of life extension whose views have been cast in mythological language. De Grey believes that "*we are close enough [to the biomedical revolution] that our action (or inaction…) today will affect the date at which ageing is defeated"*. (De Grey and Rae 2007, xi) He expects "*many people alive today to live to one thousand years of age and to avoid age-related health problems even at that age*" (325). His enthusiasm and strong belief in scientific progress is aptly described in the book's dedication as "*tirelessly and courageously bearing Promethean fire*" (vii).

Prometheus was a clever Titan god. When Zeus[3] devised a plan to wipe out the human species, Prometheus took pity on the mortals, stole fire from heaven and gave it to them. He also granted wisdom to these still rather ignorant beings, taught them various techniques and arts, and

[3]In ancient Greek mythology, Zeus was the Father or King of the Olympian gods and the supreme ruler of the universe.

in several versions of the myth, he even took part in the creation of humankind. Because of his courageous, boundary-crossing, creative and technological nature, Prometheus has become a popular icon within the human enhancement debate. With Promethean courage, de Grey bears the fire of humanity's future improvement, which is life extension.

The figure of Prometheus is also assigned an important role by Simon Young, the author of *Designer Evolution*. Young asserts that the greatest tragedies in life are human biological limitations and death. Unwilling to accept the suffering and restrictions that accompany such limitations, he put his trust in the power of science to eventually conquer them. "*Humanity will take evolution out of the hands of butterfingered nature into its own […] hands*" (38). For him, "Designed Evolution" is the *inevitable* next step in humanity's history of self-improvement; overcoming our biological limitations is no mere wish but our natural destiny. "*[The] goal of human life is survival – we are programmed that way*" (15-16). Young claims that humans naturally have *"the instinctive drive of a conscious entity to expand its abilities in pursuit of ever-increasing survivability and well-being*" (39).

This "will to evolve" is incarnate in the figure of Prometheus, who represents "*the innate human drive to increase knowledge and abilities, even at the expense of present pains*" (ibid.) – the drive to progress, improve, enhance. Although Young acknowledges that a future of self-enhancement is not without risks, he believes that rejecting the "Prometheus Drive" would mean to remain forever constrained by the power of our limitations and to continue suffering from disease and death. He writes: "*Let us be the New Prometheans. Let us unite in our commitment to boldly go where none have gone before in search of the knowledge by which to transcend the limitations of the human condition. Let us cast aside cowardice and seize the torch of Prometheus* *with both hands*" (40). In relating the tale of Prometheus, Young encourages people to employ Promethean bravery and creativity, to enlighten themselves with the fire of knowledge that will enable them to end their suffering, overcome their limitations and enhance themselves.

Mythological characters invoked by opponents of human enhancement

In contrast to the views surveyed thus far, many people seriously question the possibilities and/or desirability of technologically enhancing human beings. The ethicist Alfred Nordmann strongly criticizes the speculative and fantasizing character of the pro-enhancement arguments: *"The contemporary fascination with space travel, artificial intelligence, and genetic engineering has led to the resurrection of the age-old visions of the transcendent power of artifacts and techniques to transform the human condition. We are constantly being presented with retellings of the classic tales of conquest and ingenuity that can be subsumed under the 'myth of progress'. More than two millennia after the sun melted the wings of Icarus for coming too close, we are still under the spell of hubris, trying to fly higher and higher"* (Nordmann 2007, 32).

The myth Nordmann refers to is that of Daedalus and Icarus. While imprisoned with his son Icarus in a labyrinth on Crete, the clever craftsman Daedalus thought of a way that the two might take flight and escape their imprisonment. Thus, Daedalus created two pairs of wings out of feathers and wax, one pair for himself and one pair for his son. Before they flew off, Daedalus warned Icarus not to fly too high, but when he found himself moving freely through the air, Icarus became captivated by his enthusiasm and flew higher and higher. As he neared the sun, the heat melted the wax of his wings, his feathers fell off and the boy fell into the sea and drowned.

This myth is about *hubris*: it warns of the dangers of unrealistic imagination, over-ambition, and overestimation of one's own powers. In noting this myth, Nordmann implicitly warns of the danger that people might let themselves become seized by Icarian hubris when imagining, believing in and pursuing unrealistic objectives, such as transforming the human condition. The message here is that caution is important because over-ambition can be truly perilous.

The political philosopher Michael Sandel (2004) and the scientist and medical ethicist Leon Kass (2002) have both criticized the attitude that they believe motivates human efforts at self-enhancement. Both these thinkers believe that a deeply objectionable desire to master nature lies at the root of these efforts. Notably, following the enhancement advocates discussed above, Sandel and Kass employ the allegorical value of the myth of Prometheus. However, for these critics of self-enhancement, the story does not symbolize heroism or progress but instead warns of the dangers of ambition. Sandel argues that biotechnological enhancement represents *"[…] a Promethean aspiration to remake nature, including human nature, to serve our purposes and satisfy our desires. The problem is not the drift to mechanism but the drive to mastery. And what the drive to mastery misses and may even destroy is an appreciation of the gifted character of human powers and achievement"* (Sandel 2004, 54). Losing this appreciation, Sandel believes, threatens to undermine some of society's most cherished values: *humility* in the face of human imperfection and *solidarity* with the least fortunate.

To a greater degree than Sandel, Kass believes that what is at stake is our very humanity. Because the goals of medicine – which traditionally have been understood to be healing diseases and avoiding death – have recently been extended to include human enhancement, "*human nature itself lies on the operating table*" (Kass 2002, 4). According to Kass, we risk "*dehumanization"*, and we risk reaching the point at which we will no longer pursue anything "*humanly richer or higher*" (9) than health, amusement and pleasure. The problem with the project of enhancing humans is that it extends the drive to control nature to our very minds and souls. The "Promethean man", as characterized by Kass, is the human who has lost all her humanity due to her unsatisfiable urge for technological mastery – a materialist drive so strong in its search for enhancement that it takes away precisely what made her human and what gave life meaning: desire, pain, pleasure, love and, essentially, mortality. *"Here, the final technical conquest of his own nature would almost certainly leave mankind utterly enfeebled [...]. Homogenisation, mediocrity, pacification, drug-induced contentment, debasement of taste, souls without loves and longings – these are the inevitable results of making the essence of human nature the last project for technical mastery. In his moment of triumph, Promethean man will become also a contented cow"* (48).

Sandel's and Kass's worries correspond to the side of the Prometheus myth that enhancement advocates tend to overlook. When Zeus discovered his misdeed, Prometheus was severely punished. Zeus chained the rebellious god to a rock, where each day a vulture ate his eternally regenerating liver until, many centuries later, Heracles freed him. In other words, our drive to mastery will ultimately cost us dearly, as it did Prometheus.

Following the lead of Kass but focusing on sports, applied ethicist Mike McNamee challenges *"the hubris of modern biomedical science"* and its *"vertical ambition in transforming our very nature as humans"* (McNamee 2007, 182-3). He asks us to reflect on the concept of victory. Once you have become an elite athlete with considerably higher capacities due to technological enhancements, what would remain of the meaning of winning? McNamee draws on the Odyssey to explore this issue[4]. After his ship is wrecked in a storm, Odysseus is rescued by the divine beauty Kalypso, who offers him *"a life of endless pleasure, without suffering or fatigue". "This life"*, says McNamee, "*of course stands in marked contrast to the vulnerabilities, struggles and eventual death that define the shape of human life"* (McNamee 2013, 194). However,

[4] The Odyssey is an epic poem written by the ancient Greek author Homer. It describes the long and arduous journey of the hero Odysseus returning home from the Trojan War.

Odysseus rejects the offer and chooses instead to return to Ithaca, where Penelope, his wife, is waiting for him. He chooses to continue his mortal life, accepting both its dangers and its agony.

McNamee quotes Martha Nussbaum, who explores Odysseus' choice in her essay, "Transcending Humanity": *"We don't quite know what it would be for this hero, known for his courage, craft, resourcefulness, and loyal love to enter into a life in which courage would atrophy, in which cunning and resourcefulness would have little point, since the risks with which they grapple would be removed"* (Nussbaum 1990, 366). Even love would be different. Nussbaum wonders *"where, and who, in such a life, would our hero actually be? Do we wish for him a good result that involves a transformation so total that he might not remain himself?"* (ibid). McNamee draws an analogy to a robot that would be a perfect firefighter. While operating very efficiently and effectively, such a robot would not be considered heroic because, as a machine, it would risk nothing and would have nothing to lose. *"What is missing are the possibilities of choice, fear, an understanding of life that might be saved, or risked, and so on"* (McNamee 2013, 195).

Our disposition toward technologically transformed athletes performing excellently would surely be similar: *"Would any kind of a proverbial vocabulary, such as we employ of virtuous and vicious, be apt? The nature and limits of human excellence shape the kinds of admiration we have for those who aim at perfection, humanly conceived. The framework gives meaning to the action and its evaluation"* (ibid.).

McNamee chooses the myth of Odysseus to show that a heavenly existence of endless pleasure would deprive life of its meaning. Virtue and victory derive their value and significance from the very fact that humans have limits. Thus, the only athlete whom we can genuinely marvel at is the one who, despite these limitations, nevertheless dares to undertake the risky odyssey toward *human* excellence.

Learning from mythology?

It might be wondered why both sides of the debate on human enhancement draw so heavily on ancient Greek mythological figures. At first glance, it might be thought that these myths are simply convenient and apt illustrations of the positions taken by different debaters that make their views more vivid and accessible without having much to do with the *content* of these views. We agree that ancient myths can be clarifying illustrations of elusive philosophical concepts. However, their sheer ubiquity suggests that they are more than that. We suspect that it is no accident that participants in the enhancement debate constantly return to *these* particular myths (rather than to other narratives). There is continuity between these myths and the variety of views on human enhancement in that these views are colored by the same complex attitudes that these myths have inspired over the course of their history. When proponents of enhancement invoke Prometheus, they express admiration for his bravery and thrill at transcending the boundaries that this myth has always evoked. In addition, when enhancement critics invoke Icarus, they give voice to the awareness of danger and humility in the face of human limitations that this myth has conveyed since antiquity. In this sense, contemporary thinking on human enhancement is part of the living and evolving legacy of these myths.

What, if anything, can we learn from recognizing that mythology not only illustrates different contemporary views on enhancement but also helps shape these views? The pessimistic conclusion is that we might as well abandon any attempt to solve the perplexing socio-ethical questions that the possibilities of human enhancement raise. If the ancient Greeks grappled with these questions and if humanity still has not answered them despite its attempts over the last two and a half millennia, can we genuinely hope to be able to answer them today? Better, it seems, to spend our time and energy on more worthwhile pursuits that might have a direct impact on the problems that humans currently face.

Although such pessimism might not be altogether unwarranted, we want to hint at a different and more productive conclusion. There is an important sense in which confronting the history of our thoughts and passions renders them more comprehensible. Indeed, this insight animates a range of different intellectual traditions: from Marxism through psychoanalysis to hermeneutics.[5] Explicitly or implicitly, these traditions all assume that reflecting on the origin and evolution of present ideas and attitudes – on how these ideas and attitudes came about – allows us to understand them better. In this spirit, we suggest that taking their mythological references seriously might make participants in the human enhancement debate more humble regarding their own views. There is no doubt some truth to the charge that enhancement critics remain in the grip of irrational fears, just as there is some truth in the charge that enhancement enthusiasts are overly excited about current prospects for human enhancement. To the extent that both fear and excitement can cloud reasoned judgment, they must sometimes be tempered. Tracking the history of such reactions is useful in this regard because it provides a critical perspective on them. Enhancement critics have much to benefit from realizing that concerns about new practices and technologies have sometimes proven unwarranted. Similarly, enhancement proponents have much to benefit from realizing that enthusiasm for scientific and technological progress has sometimes proven to have been overblown. Such realizations might make each side of the debate more cautious with respect to their own convictions and, ideally, more likely to recognize that they share more than they might think with the other side (Parens 2005). Although it largely reiterates ancient

[5] Hermeneutics is the classical 'theory of interpretation'. Today, it continues to be used in various forms and disciplines as a method of studying and explaining texts, human beings and human phenomena. It is essential in hermeneutics to interpret the object of study within its (historical) context and its parts within a larger whole.

and unresolved socio-ethical quandaries, there is yet hope for progress in the debate on human enhancement.

References

De Grey, Aubrey and Michael Rae. 2007. *Ending Ageing: the Rejuvenation Breakthroughs That Could Reverse Human Ageing in Our Lifetime*. New York: St Martin's Press.

Gems, David. 2011. "Tragedy and Delight: the Ethics of Decelerated Ageing." *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 1561: 108-112.

Kass, Leon. 2002. *Life, Liberty and the Defence of Dignity*. San Francisco: Encounter Books.

McNamee, Michael J. 2007. "Whose Prometheus? Transhumanism, Biotechnology and the Moral Topography of Sports Medicine". *Sports, Ethics, and Philosophy* 1 (2):181-94.

McNamee, Michael J. 2013. "Transhuman Athletes and Pathological Perfectionism: Recognising Limits in Sports and Human Nature." In *Athletic Enhancement, Human Nature and Ethics. Threats and Opportunities of Doping Technologies*, edited by Jan Tolleneer, Sigrid Sterckx, and Pieter Bonte:185-98. Dordrecht: Springer Verlag.

Nordmann, Alfred. 2007. "If and Then: A Critique of Speculative NanoEthics." *NanoEthics* 1: 31–46.

Nussbaum, Martha C. 1990. "Transcending Humanity". In *Love's Knowledge. Essays on Philosophy and Literature.* Oxford: Oxford University Press.

Parens, Erik. 2005. "Authenticity and Ambivalence: Toward Understanding the Enhancement Debate." *Hastings Center Report* 35 (3): 34-41.

Sandel, Michael J.. 2004. "The case against perfection: what's wrong with designer children, bionic athletes, and genetic engineering.". *Atlantic Monthly* 292 (3): 50-4, 56-60, 62.

Young, Simon. 2006. *Designer Evolution. A Transhumanist Manifesto*. New York: Prometheus Books.

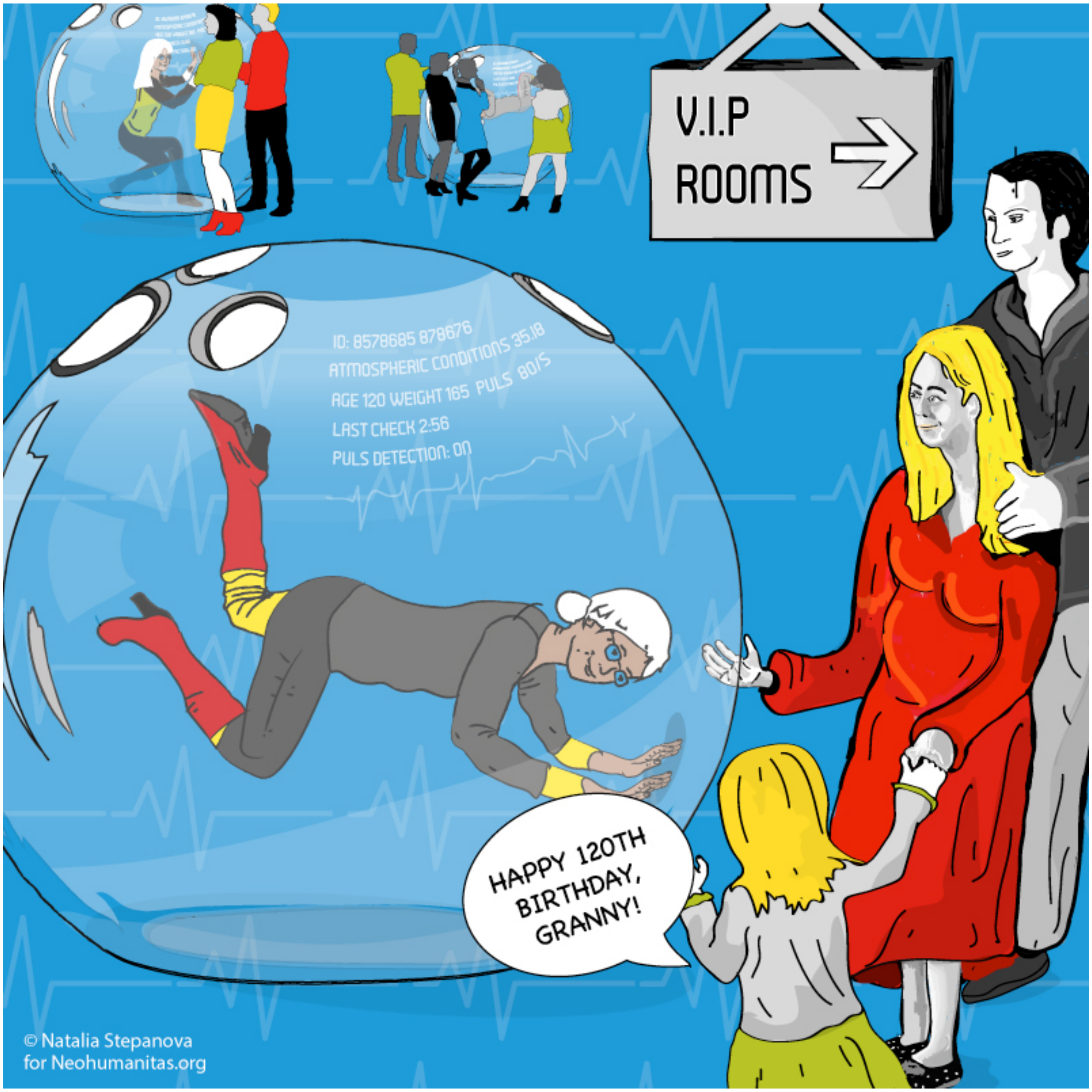


Illustration 6 "Science and technology, towards enhancing the human condition" by N. Stepanova

Chapter 6: Science and technology, towards enhancing the human condition

Laura Cabrera, Xaroula Kerasidou and Olivette Burton.

"Humanity faces an uncertain future as technology learns to think for itself and adapt to its environment." (Stephen Hawking)

In recent decades, the scientific world has witnessed a surge in the implementation of ideas originally conceived in science fiction. Feats previously understood as objects of imagination are now understood as goals to be pursued by interdisciplinary groups of individuals including, but not limited to, scientists, engineers, and people working in the humanities and the arts. These modern progressive thinkers are arguably taking us toward a technological revolution that will change our lives in unprecedented ways, much like the industrial revolution changed Europe during the 19th century. In this chapter, we first introduce some of the technological developments in the fields of computer science and information technology that are thought to be of great promise for human enhancement. Second, we address and discuss some of the socio-ethical and political issues related to the implementation of such technologies.

Computer science and information technology: a 'smarter' technological world

Artificial intelligence (AI) addresses the study, development and use of "intelligent" machines and software. Most of us have been introduced to AI mainly in science fiction literature, movies and media, with images such as HAL's red camera eye – the sentient, calm, yet murderous computer that controls the systems aboard the spacecraft in Stanley Kubrick's *2001: Space*

Odyssey (1968). Highly intelligent AI, such as HAL, very much remains a futuristic vision shared by a few commentators and does not depict reality. Nonetheless, what has been termed "weak" (or "narrow") AI is already at the core of many aspects of our everyday lives. Weak AI is typically focused on narrow tasks and exhibits limited intelligence and no traces of sentience. Medicine, engineering, finance, entertainment and many military applications rely on weak AI. Current forms of weak AI can schedule appointments, allocate resources for large corporations, make financial predictions, play chess and land aircraft. Many – if not most – smartphone applications rely on various forms of weak AI. When surfing the Internet, AI programs run in an attempt to give you the best answers you are seeking. Some Internet search engines not only provide what you are looking for but also examine the personal aspects of the person asking. For instance, the Google web browser personalizes answers to requests based on "who" has asked, "from where" and at "what time". In so doing, the AI running in the background of the search tends to match both the detailed knowledge of the searcher's profile with the object of the search itself, which is undertaken to deliver the best possible answers to the searcher's request.

However, what if you did not even have to look at your phone or a web browser to access the information you need? What if all this information was accessible from practically anywhere, anytime? Being surrounded by information anywhere and anytime as we move through our everyday lives and computers have disappeared into the background is the vision of a different computing paradigm known as "ubiquitous computing" or "ubicomp". Imagine waking up to the sound of your alarm clock right on time for your morning appointment and with the smell of freshly brewed coffee. Your alarm clock had consulted your work schedule the night before and alerted the coffee machine to start preparing your morning coffee minutes before it went off. You glance out the window, and a display of the day's forecast appears at the corner of your eye, blending in with the sight of the morning hustle and bustle of your street, calmly and seamlessly blending the real and the virtual.[6] This is the vision of ubiquitous computing, also known as “smart computing”, “ambient intelligence”, or “the Internet of Things”. Although it first appeared in the late 1980s, it has lately gained considerable traction as both industry[7] and policy makers[8] proclaim to have turned their attention to building a computationally enhanced future that focuses less on machines (intelligent or otherwise) than on people themselves. Ubiquitous computing promises to serve and support people by using numerous, ubiquitous, invisible machines embedded in environments and everyday objects, such as pens, books, watches, buildings, walls, furniture, and clothes. As Bill Gates (2003) puts it: *“All this will lead to a fundamental change in the way we perceive computers. Using one will become like using electricity when you turn on a light. ... We will be focused on what we can do with computers, not on the devices themselves. They will be all around us, essential to almost every part of our lives, but they will effectively have "disappeared"’.*[9]

Although it might be said that we still have a long way to go until such visions become reality, some commentators claim that we are already living in an ubicomp world. The ubiquity of smartphones in every aspect of our lives, whether personal or professional, might be understood as evidence that we are already immersed in a computational experience that blends the virtual and the real. Even if your smartphone looks too much like an attention-seeking computer to qualify as an “ubicomp experience”, some of the newest wearable smart devices might be more convincing.

---

[6] This future scenario is based on the scenario Mark Weiser used in his paper "The Computer for the Twenty-First Century," Scientific American, pp. 94-10, September 1991, which introduced ubiquitous computing for the first time.
[7] See, for example, http://www.microsoft.com/eu/whats-next/article/ubiquitous-computing-serving-user-needs-anytime-anywhere.aspx
[8] In 2001, this vision of Ambient Intelligence was adopted by the European Commission’s Information Society and Technology Advisory Group (ISTAG) as the main theme of the Sixth Framework (FP6) in Information, Society and Technology (IST) Research in Europe (ISTAG 2001), whereas in 2007, the European Research Cluster on the Internet of Things (IERC) was established.

[9] http://www.microsoft.com/presspass/ofnote/11-02worldin2003.mspx

Devices such as “Google Glass” (smart eyewear that promises to provide information as and when we need it) or “smart watches” (which track the wearer’s movements and monitor health and fitness) might give you a taste of an ubicomp experience. Furthermore, the experience does not stop there. For years now, industrial and academic centers have focused on developing smart living spaces that promise unprecedented levels of convenience, comfort and enjoyment. These technologically controlled environments can monitor, control and manage many aspects of our everyday lives: from the health and general well-being of senior citizens to air and water quality, atmospheric conditions and our domestic energy consumption.

Of course, there are many more examples of how science and technology might modify people’s everyday lives. For instance, there are already prototypes of smart cars that can drive alone, which will make our travel safer. Similarly, brain-computer interfaces, augmented reality glasses and robots can already assist in surgery or rescue people in dangerous situations. The potential is huge, but so are the possible pitfalls.

Technologically enhancing our evolution?

Technologies developed by means of AI and ubicomp (*i.e.*, smartphones, games, and/or other technologies that automatically regulate the temperature or lighting in our homes for our comfort) are marketed to us as a cool or even essential part of our everyday lives. Thus, in 2014, United States Supreme Court Chief Justice John Roberts was quoted as saying: “*Modern cell phones are such a pervasive and insistent part of daily life that the proverbial visitor from Mars might conclude they were an important feature of the human anatomy*”.[10]

10 RILEY v. CALIFORNIA, 573 U. S. Opinion of the Court (2014):p.9.

Some are excited about the possibilities of introducing more technological tools that might enhance our everyday lives. Raymond Kurzweil – the well-known inventor, engineer and advocate for advancing and developing technology for human enhancement[11] – has predicted that, by 2040, the non-biological part of our being will exceed by far our biological component and that there will be no difference between human and machine or between physical and virtual reality (Kurzweil 2005). Kurzweil has also explored ideas involving how artificial intelligence can expand and enrich human capabilities; in particular, he sees the merging of humans with technology as the only way in which humans can stay competitive in a world in which our machines are approaching human-like intelligence. However, not everyone is excited or optimistic about the possibilities of technologically enhancing ourselves. Hence, a discussion regarding the perils and implications of technological enhancement is necessary.

There are voices from the fields of philosophy, the social sciences and the humanities that point to a broad spectrum of ethical, social and political issues that must be carefully considered when thinking about science and technology and their relationship to society and humankind. These voices range from concerns revolving around the loss of autonomy and the subversion of free will to fears that technology will somehow replace the human[12] and therefore make humans less important and more dependent on technology. There are also concerns that delving deeply into the realm of AI is akin to playing God and thus not within the purview of humans and arguments that claim that science and technology should be addressed with neither fear nor awe because such responses assume that both fields are somehow external to and independent of society and culture.

---

11 Ray Kurzweil, The Singularity Is Near (Penguin, 2005).

[12] F Fukuyama, *Our Posthuman Future: Consequences of the Biotechnology Revolution - Francis Fukuyama*, (New York: Farrar, Straus and Giroux, 2002).

Instead, they should be examined as interdependent phenomena that shape one another.[13]

Specifically, while science and technology rush forward, some raise social concerns regarding the access and equitable distribution of their benefits and how these factors will impact humanity. Unequal access to these technologies might increase the global inequality gaps that divide nations and populations. In a world in which millions of people still do not have access to clean water, food and/or essential medicine, all-obliging intelligent robots or smart kitchens that automatically order milk when it is running low appear superfluous at best and irresponsible at worst. These social concerns are based on the view that science and technology should serve society, address its problems and serve its needs rather than finance vanity projects that benefit or are affordable and relevant to only a very small fraction of the global population.

Others are concerned about the accompanying privacy and surveillance issues. For example, "Google Glasses" are now being used by many law enforcement agencies in pilot programs as tools to provide more security to the public. In its efforts to fight crime, the New York City Police Department has purchased several pairs of these glasses, which can call up both building schematics and a suspect's criminal history, in addition to allowing law enforcement agencies to freely share information. However, how will the primary objective of enhancing public safety be balanced against possible violations of privacy and the readily accessible information on individuals who may or may not be suspects? Whereas the latest smart technologies promise to track our every step to closely tailor their services and enhance our everyday lives in meaningful ways, there are questions regarding the use of such technologies to collect, manage and potentially abuse such large sets of data on private persons.

---

[13] Cf. Haraway, *A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century* (1991); Wiebe E Bijker et al., *The Social Construction of Technological Systems* (MIT Press, 2012).

Whereas some are concerned with the consequences that new technological advances might have for society and human beings, others seek to examine the claims and promises that these new technologies make in the first place. For example, rather than taking for granted science and technology's promises of a better future, it might be more important to begin by examining the following question: how can we ensure that our technological advances accord with our values? According to American ethicist Leon Kass, "*the technological way of thinking has infected ethics, which is supposed to be thinking about the good*". Hence, when reviewing all the things that have been accomplished in conjunction with the envisioned promises and perils of technologies – such as AI or ubiquitous computing – there is a concern that we may have become biased in our socio-ethical discussion. In other words, we might have forgotten what constitutes recognizable progress that results in a "good quality of life". Ill-planned and poorly implemented technological advances can make us lose sight of what we value, such as having time to "really" interact with other humans (and not only online). They can also make us deplete natural resources as we continue to build an ever expanding infrastructure; they can even harm us in the pursuit of *being better* rather than *being well*, hence disregarding the importance of our human limitations.

Moreover, others argue that it is not only the ethical implications that must be examined but also the politics underlying such visions. These voices call on us to consider not only the power relations that such visions (re)produce but also *who* gets included and *who* is excluded from these technological worlds.[14] Although humans have always attempted to draw boundaries, we must

---

[14] Chasin A. 'Class and Its Close Relations: Identities Among Women, Servants, Machines'. In Halberstam J. and Livingston I. (eds.) *Posthuman Bodies*. (Bloomington and Indianapolis Indiana University Press, 1995): pp.73-96 ; Star, S. L. Power, technology and the phenomenology of conventions: on being allergic to onions'. *The Sociological Review*, *38*(S1), (1990), 26-56.

bear in mind that there are no pre-determined methods to determine where these boundaries could or should be drawn. Differences matter, and the ways in which boundaries are drawn – what constitutes a "natural", a "technological", a "contaminated", or an "enhanced" human – remain questions that are worthy of constant examination and adjustment that must remain subject to persistent questioning and re-evaluation.

Thoughts for the future

Scientific and technological advances must be examined and challenged and not simply be taken for granted as we allow ourselves to become carried away with the "next big thing". They must be investigated repeatedly so that we can examine the power relations that these technological advances produce or reproduce. Many questions might serve as a beginning for deep reflections. For instance, in a world in which millions of people remain without access to clean water, food or essential medicine, how does a digital gadget that detects your blood sugar help pay for the medicine you need but cannot afford or the dinner you have not eaten? What happens to all the people who somehow are not included in this seemingly universal 'we'? Moreover, are these advances genuinely concerned with 'helping people'? With respect to all the rhetoric surrounding useful services, having information at our fingertips, and *easy this and easy that,* who actually benefits from this technology and what does it actually enable him or her to do or be? Who decides what the common good is, what the types of technologies are that we need or desire, and how we distinguish the technologies that are for the common good from those that serve only certain individuals, companies or governments? In attempting to answer such questions, we may reach a better understanding of the type of world in which we would like to live. Rather than blindly following an individual's selfish desires and radical techno-futuristic visions of humanity, an open socio-ethical and political discussion regarding the use of science and the promises of technological advances is necessary to ensure the responsible, sustainable and ethical development of such technological visions.

References

Gates, Bill. 2003. *The Disappearing Computer*. Microsoft and Publishing House New Center. http://www.microsoft.com/presspass/ofnote/11-02worldin2003.mspx.

Kurzweil, Ray. 2005. *The Singularity is Near*. New York: Penguin.

Illustration 7 "Playing with the "Playing God" by N.Stepanova

Chapter 7: Playing with the "Playing God"

Hossein Dabbagh and Elena Andreeva

Anderson Cooper, CNN: "You're saying doctors play God all the time?"

Dr. Kevorkian: "Of course. Any time you interfere with a natural process, you're playing God. God determines what happens naturally. That means that, when a person is ill, he shouldn't go to a doctor, because he's asking for interference with God's will."

Modified from CNN transcripts, April 15th, 2010

Dr. Jack Kevorkian was a zealous activist for euthanasia. Beginning in 1990, the infamous "Doctor Death" helped more than 100 people end their own lives by lethal injection. In an interview, when accused of "playing God", Kevorkian retorted that he was as guilty as any other doctor, given that they also step into God's shoes of determining destiny by interfering with the natural processes of the human body.

Not everyone goes as far as Kevorkian in claiming that all medical interventions count as "playing God." This charge is more commonly leveled against practices such as capital punishment and abortion, in addition to *in vitro* fertilization more recently, pre-natal screening and genetic engineering. The common denominator among these issues is that they all concern something for which personal responsibility is not easily taken; they all concern something that is considered so serious that we would rather pass the care and the blame on to God – or to fate or to chance – rather than face the responsibility for it ourselves, and they concern something that has been traditionally placed in the realm of the sacred: human life.

Destruction of human life, creation of human life, modification of human life from its original form – dare we take these things into our own hands? Do we have the right to do so? Human enhancement, as a prime example of this final category, naturally raises the same concerns. Already we taunt fate when we decide – as part of the accepted procedure of *in vitro* fertilization – which of our embryos will go on to become life – those with two X chromosomes or those with a Y chromosome. In addition, as our skills in genetic engineering grow more refined, we may soon see the advent of "designer babies", whose lot in life with respect to attractiveness and intelligence will be cast not by Fate but by their parents in choosing their genes.

We have never been as close to treading on this "forbidden soil" of the gods as we are today; that much is clear. If there was ever a time to heed the legend of Icarus, today is the day. Theologians and philosophers alike issue warnings against our growing obsession with self-enhancement. Domenico Mogavero, Bishop of Mazara del Vallo, has denounced the modification of creation from its original design as an "enormous risk" that threatens to make humans barbarians. "In the wrong hands, today's development can lead tomorrow to a devastating leap in the dark".[15] In the same vein, Harvard's Michael Sandel (2007) and Ronald Dworkin (2002) have noted that, by being perpetually dissatisfied with the natures that we have been given, we fail to appreciate the beauty of our imperfections; thus, in striving to reach some imagined ideal by any means, we risk destroying the very traits that make us human.

These thinkers may very well have some valid points. However, one question must be raised. How certain are we, really, that we are indeed "playing God" when we take a more active

[15] See http://www.foxnews.com/world/2010/05/21/italian-cardinal-synthetic-cell-sign-intelligence-ethics-considered. For an alternate view advocating "human enhancement", see Kahane (2011; 2013).

role in determining our bodies' physical fates? What type of evidence is such an assumption based? Is there a theological foundation for it?

Within the three main Abrahamic religions (Judaism, Islam and Christianity), *divine providence* is a prominent theological concept. Unlike Isaac Newton, who saw God as a "retired architect", these three theistic traditions reject the idea that God abandoned the universe upon its creation. Instead, as with René Descartes, who needed God to account for time, theists from these three main Abrahamic religions assert that God continuously protects, guides, preserves and takes care of His world. In addition, if God chooses to take an active interest in His creation, who are we to contest Him for maintaining control over it? Dare we claim that the manner in which God made us is not good enough and that, despite His care and involvement, we nevertheless would like to "play" His role, taking it upon ourselves to tidy up God's mistakes and make a few much-needed upgrades to our bodies and/or minds?

Perhaps, out of full respect for Providence, we should abandon all attempts to meddle with creation. Perhaps all doctors should go out of business as we stay home to let nature take its course. Is this the outcome to which Abrahamic theology leads us? If we conclude that respecting God's will means relinquishing all control over creation, we come into a conflict with another prominent theistic notion: *free will*. Our bodies are as much as anything a part of God's creation, yet here we are, apparently in charge of them (and even held responsible for wielding them for good over evil!). How is it possible that the concepts of divine providence and free will can co-exist?

One solution is to assume that free will is *itself* a part of God's plan, that the Creator chooses, as it were, to be the One relinquishing control: control over the conscious part of His creation to give *them* the power to choose (and, as a consequence, be held responsible for choices that they make). If that is the case, then why not imagine that God and humans can work together in parallel with one another, making us, in the words of the Australian philosopher C. A. J. Coady, *"co-workers with God"* (2009, 156)? For instance, God might have created different forests and lakes, but if humans plant more trees and/or dig artificial lakes, would they necessarily be interfering with His plan? We might pray to God for healing from disease, but does this mean that we are not allowed to pursue a career in medicine or research? In both Christian and Islamic culture and traditions, we find sayings such as "*Man proposes, God disposes"* and *"God helps those who help themselves"*. Theology actively urges human beings to go, find, and create what is hidden and unfolding in God's providential plan. According to this perspective, we are not playing God in the sense of taking on the role of God; instead, God allows us to play together *with* Him, within His universe.

What does theistic theology tell us about the exact nature of our joint work with God? In the Koran, it is written: "*Just recall the time when your Lord said to the angels: 'I am going to appoint a vicegerent on the Earth'" (1:30).* Such a vicegerent – or *Khalifah* – as it is interpreted, means one who exercises delegated powers on behalf of another. As *Khalifah*, a human is therefore not the master himself but an agent of his Master, Allah. According to Islamic tradition, human beings thus do not have the right to their own will but are in this world to fulfill the will of the delegating Authority, Allah.

The Bible offers insights from a different angle: *"So God created mankind in His own image, in the image of God He created them; male and female He created them"* (*Genesis* 1:27). An image, although with a fundamentally different nature from the object it depicts, nevertheless captures and expresses all its characteristics. Thus, Christianity teaches that human beings have been created with the potential to express the qualities and skills of their Creator, including the skill of creation itself.[16] Whether a poem, a painting, a symphony, or simply the choice between right and wrong, a person endowed with free will should have the capacity to impact the future in an unprecedented manner (*i.e.*, to create something truly original).

However, theistic theology emphasizes one fundamental distinction between our creative capacity and God's. As an uncaused Cause of everything that exists, God creates *ex nihilo* – out of nothing. The Koran states, *"His command is only when He intends a thing that He says to it, 'Be,' and it is" (36:82).* The Bible implies the same idea: *"By the word of the Lord were the heavens made, their starry host by the breath of His mouth"* (*Psalms* 33:6). *Ex nihilo* creation remains beyond human reach. As part of the created material universe, we are subject to its physical laws, including the law of the conservation of energy. As long as that law holds, we cannot make the objects of our desire materialize out of thin air without exerting some energy to procure them first. In addition, although our ideas may be completely original, they will nevertheless always remain a product of the pre-existing neural web of our brains. Thus, the fear of encroaching upon God's realm can be safely put to rest: even if we wanted to and dared take on His role, we could never overcome our *a priori* basic limitations.

However, within the material world, God *has* given us freedom to be original, theists claim. Why, then, should we be afraid to create something "unnatural"? Would God actually object if we used our knowledge of genetic engineering to make a striped white-and-purple petunia plant (which may very well have never evolved as such on its own), or to reducing drastic food shortages

[16] Although there is no similar statement in the Koran, the exact same verse can be found in a very popular *Hadith*, on which Islamic mystics such as Ibn Arabi have based their belief that human beings have the same *essence* as Allah and may therefore be considered to be one with Him. This idea contradicts that of jurists or Muslim traditionalists, who believe that Allah and man are of fundamentally different natures. In Christianity, the only human believed to have shared God's essence is Jesus Christ, being *begotten* from God the Father, not created by Him like the rest of humankind.

in the developing world by giving crops "artificial" pest-resistant genes, or to relieving the symptoms of Parkinson's disease and major depression by implanting platinum electrodes into the human brain? To not make full use of our skills in the face of the challenges confronting our century would be akin to resigning to death on a sinking ship by refusing to fix a leak. One needs only to recall the Parable of the Talents to know what Jesus Christ thought of such an attitude.[17]

However, as with all good intentions, the human condition – or simply, our thoughtlessness and greed – persistently obstruct our way. As technology develops, our power to tap the planet's resources grows; however, we do not simply tap but use a sledgehammer instead. We know that the havoc wreaked by our insatiable consumption is wreaking havoc, in turn, on the environment. However, we continue importing, jet-setting and eating meat from our factory farms. If we were indeed fashioned by a loving Creator, could this relationship genuinely be the relationship between humankind and the rest of His creation that He envisioned?

Genesis 2:15 describes the intended relationship in the following: "*And the Lord took the man, and put him into the Garden of Eden to work it and to keep it.*" What do the tasks of "working" and "keeping" imply? In the first five books of the Bible's Old Testament (Genesis, Exodus, Leviticus, Numbers, and Deuteronomy, collectively known as *the Torah* in Judaism), the only other instances in which the Hebrew words for "work" and "keep" are used are in reference to the duties ascribed to priests in watching over their temple (*Numbers* 3:5-7). Jewish scholars note the pervading parallels between the story of creation in the Book of *Genesis* and the construction of

[17] In the Parable of the Talents (from which the English word "talent" originates), Jesus tells a story of a nobleman who went away on a journey, entrusting his property to his servants in the form of talents (a unit of currency), in amounts according to their abilities, to use in whatever way they saw fit. While two servants took advantage of the opportunity, using the money to make a profit, one servant did nothing, simply returning the talents untouched to his master upon his return. Praising the first two for their resourcefulness, the nobleman harshly rebuked the servant who did not make use of his gift: "throw that worthless slave into the outer darkness, where there will be weeping and gnashing of teeth" (*Matthew* 25:14-30).

this temple – the tabernacle – in the Book of *Exodus*. By instructing human beings to "work and keep" the garden, God is, in fact, entrusting us with the roles of priests – and our temple is the rest of creation.

The Islamic and Christian traditions teach that, as priests, human beings are meant to bless and sanctify creation, not to abuse, dishonor, or exploit it. We are meant to treat creation with deep appreciation for the fullness of its intrinsic value as the work of God's hands. The human body, as part of creation, deserves to be treated with the same reverence, and all the more so. New Testament language repeatedly refers to the body as the temple of the Holy Spirit (1 *Corinthians* 3:16-17). The Apostle Paul teaches that, when we become members of the Christian Church, our bodies become members of a single body – the body of Christ – and as such, the dwelling place for the Spirit of God (*Ephesians* 2:19-22). Muslim jurists and mystics frequently refer to Prophetic sayings and Koranic verses, such as *"Surely we belong to Allah and to Him we shall return" (1:156)*, to insist that people are able to become God's hands, eyes or ears in this world.[18] Therefore, human beings are understood as intrinsically holy.

As the possibility of enhancing the human body through biotechnology becomes increasingly real, the "playing God" allegation will inevitably be raised repeatedly. Human life is valued deeply by both believers and non-believers alike, and given the history of our careless technological trampling of planet Earth, the concern is both understandable and pertinent. However, as argued above, there is not much theological basis on which to rest such a claim. The human capacity for creation cannot be placed on the same plane as God's creative capacity; to

[18] See Sahih al-Bukhari (6502). Also, Jalāl ad-Dīn Muhammad Rūmī, a prominent Muslim mystic, says in this regard:
Form is born of That which is without form,
And goes again, for, "Verily to Him do we return" (*Masnavii Ma'navi*, 1141).

consider ourselves capable of encroaching upon His domain is a testament to our deep-seated arrogance. However, religious traditions and texts affirm that, within the creative capacity that we *do* have – having been made in God's image and having been granted free will – we are encouraged by God to use all our talents to improve our lives. When searching for the appropriate limits in our quest for improvement, however, we should consider the centuries-old wisdom of the Abrahamic religious traditions and take a page out of the Koran, the Torah, and the Bible as we strive to approach the task of human enhancement with due reverence and respect.

References

Coady, Cecil A.J. 2009. "Playing God." In *Human Enhancement,* ed. Julian Savulescu and Nick Bostrom. New York: Oxford University Press, 155-80.

CNN. 2010. "Anderson Cooper 360 Degrees". *Interview with Jack Kevorkian*, Aired April 15, 2010. http://transcripts.cnn.com/TRANSCRIPTS/1004/15/acd.01.html.

Dworkin, Ronald. 2002. "Playing God: Genes, Clones and Luck." In *Sovereign Virtue,* 427-51. Cambridge, MA: Harvard University Press.

Kahane, Guy. 2011. "Mastery without Mystery: Why There Is no Promethean sin in Enhancement." *Journal of Applied Philosophy* 28 (4): 355-68.

Kahane, Guy. 2013. "Designing Children and Respect for the Given." In *Ethics for the Future Life*, ed. Tetsuji Uehiro, 81-88. Oxford: Oxford Uehiro Centre for Practical Ethics.

Rūmī, Jalal ad-Din Muhammed. 2001. *Masnavii Ma'navi*: *Teachings of Rumi.* Translated by Edward H. Winfield. London: Routledge.

Sandel, Michael J. 2007. *The Case Against Perfection*. Cambridge, MA: Harvard University Press.

Illustration 8 "How individual enhancements can cause social change" by N. Stepanova

Chapter 8: Be the best version of yourself: How individual enhancements can cause social change

Cynthia Forlini, PhD[1] and Tugce Bilgin[2]

[1]The University of Queensland Centre for Clinical Research, The University of Queensland

[2]The University of Zurich

Discussions regarding the social outcomes of human enhancement frequently evoke images of bionic humans and Brave New World utopias in which individuals perform at the top of their physical and mental capacities. Whether the enhancements are biological, physical, cognitive or behavioral, they are meant to improve "some capacity (or characteristic) that normal human beings ordinarily have" and may even produce new capabilities (Buchanan 2010). For proponents of human enhancement, this change represents the essence of what it means to advance and flourish as human beings. However, for critics of enhancement, it represents the erosion of human nature. Both of these perspectives adhere to ideals of human performance that define a "good life" (Roduit, Baumann, and Heilinger 2013). Human enhancement can be regarded as an integral part of a good life and as an opportunity for individuals to be the best versions of themselves, but it may simultaneously be regarded as a disruption in the fabric of society. In one manner of speaking, human enhancement represents both of these facets. In this chapter, we explore how seeking biomedical enhancements to be the best version of oneself impacts individuals and society. We discuss the example of how changes in society may be shifting the goals of medicine from treating illness and dysfunction toward “wish-fulfillment”.

Enhancing individuals

When broadly considered, enhancements appear pervasive in human activity. Corrective eyewear, immunization, modifications to the human genome and psychopharmacology all fall under the heading of biomedical enhancement (Harris 2007). These biomedical innovations were achieved by means of literacy, numeracy, and science, which are types of enhancements in human activity in and of themselves (Buchanan 2010). For this reason, it is frequently argued that “[h]uman history – or at least human progress – is in great part the story of enhancement” (Buchanan 2010). It is understandable – and perhaps even expected – that humans continue to seek, create and use enhancements to produce “healthier, longer-lived, and altogether ‘better’ individuals” (Harris 2007). If enhancement is an integral part of human activity and enhanced individuals can lead rich lives and meet their goals, why is there opposition to it? The opposition hinges on the perception of whether an enhanced individual is *authentic* compared with the un-enhanced or “natural” individual.

Distinctions have been made in the ways authenticity can be understood. Authenticity can be based on: (1) what is valuable to an individual (“wholeheartedness”); (2) honesty and autonomy in the choices one makes; and (3) a “true self” that, to a certain extent, consists of natural gifts (Erler 2011). Critics of human enhancement mainly take issue with the manner in which enhancement might modify one’s natural gifts. By using enhancements to confer capabilities that one might not otherwise possess, an individual bypasses the discipline and effort that is expected to achieve excellence, promote human flourishing and establish identity (Kass 2003). In particular, the concerns over authenticity relate to genetic manipulations that enhance cognitive performance and mood because these traits are considered fundamental to personal identity. Indeed, enhancement of these traits evokes the most stringent moral objections (Riis, Simmons, and Goodwin 2008). Conversely, it has been argued that “[t]o be authentic is to find one’s way in life and one’s values *within*; it is to make one’s entire life an expression of who one truly is” (Levy 2007). Enhancement can be one way of pursuing a desired trait and ultimately self-actualizing, whether by changing one’s disposition or reaching a certain performance level (Kramer 1997). The trait remains authentic and the means appropriate provided that the choice is motivated by self-creation, based on the individual’s values and self-conception, and does not distort one’s view of the world (DeGrazia 2000; Dees 2007). Through enhancement, individuals can have the opportunity to be the best *versions* of their true selves without changing who they fundamentally are.

If the opportunity to be the best version of yourself exists, does it mean that you must take it? At this point, using enhancement technology is considered voluntary self-improvement (Caplan 2003). Research has shown that the public accepts that individuals make personal choices (within the limits of the law) when deciding to use a biomedical enhancement that they consider necessary to achieve their goals (Forlini and Racine 2009; Fitz et al. 2014;). Similarly, abstaining from enhancement should also be considered an acceptable personal choice. Although the ideals of human performance are already the subject of the ethical debate, the fear is that these ideals, particularly for proponents of human enhancement, will lead to an expectation and even pressure to use enhancements in performance-based communities, cultures, and workplaces (Racine and Forlini 2009; Heilinger and Crone 2014). Although individuals might not necessarily be obligated to use a biomedical enhancement, they might feel that they should do so to compete and meet social, cultural or professional expectations (Forlini and Racine 2009). When enhancement is motivated by external pressures, it may no longer be considered an authentic act because it constitutes conformity rather than self-actualization. Freedom from coercion with respect to human enhancement is precious common ground for those on opposite sides of the ethical spectrum because such freedom preserves authenticity.

Would enhanced individuals make a better society?

The previous section explored human enhancement from the perspective of the individual. Individuals have the potential to optimize performance and the freedom to choose to do so, a choice that may ultimately be colored by novel ideals regarding human performance. However, the opposite may also occur. Whitehouse and colleagues hypothesize that “we cannot change ourselves without disturbing that larger web of identities”, which means that “personality changes are by necessity a community event and should be undertaken as such” (Whitehouse et al. 1997). These authors warn that, cumulatively, individual decisions may become social decisions. How, then, might individual decisions regarding individual enhancement affect society?

One might reasonably argue that the cumulative effect of enhanced individuals on society is necessarily positive. Human enhancement empowers individuals by giving them the freedom to practice self-determination to (1) be the best and most authentic versions of themselves and (2) overcome physical or cognitive constraints that may limit their participation in society (Heilinger and Crone 2014). Enhancement reduces suffering for individuals who are unsatisfied or limited by their situation and improves their quality of life (Caplan 2003; Harris 2007;

Buchanan 2010). It is for this reason that proponents of enhancement consider the more conservative perspectives to be limited and short-sighted:

> “[c]onservatives who oppose the use of biological, internal technological, and other private enhancements are guilty of a crude form of social determinism, predicting some adverse social consequence of allowing enhancement when it is within our power to prevent these adverse social consequences and reduce inequality” (Savulescu 2006).

By permitting and encouraging enhancement, societies would promote equality of opportunity and level the playing field for all its members (Savulescu 2006). Society is not necessarily a zero-sum scenario in which one individual’s gain is another’s loss (Buchanan 2010). Instead, enhanced individuals would contribute talents and skills to create a better society overall.

There are some negative effects that may arise from widespread biomedical enhancement. Human enhancements that meddle in the natural lottery “represent a kind of hyperagency – a Promethean aspiration to remake nature … to serve our purposes and satisfy our desires” (Sandel 2004). Humans can innovate but would overstep their bounds by engineering the natural lottery. Biomedical enhancements run the “danger of violating or deforming the nature of human agency and the dignity of the naturally human way of activity” (President's Council on Bioethics 2003). This perspective does not consider enhancement to be a valid mode of self-actualization. Self-actualization is supposed to be achieved through effort and hard work. Anything else is cheating and unethical. Individuals who do not use different types of human enhancement may find themselves at a disadvantage within a society that values a level of performance that may otherwise be unattainable. Another possible consequence may be for enhancement to breed extreme equality. Kamm argues that altering or choosing human traits is inappropriate, not because it changes who we are but because, due to a “lack of imagination”, everyone might choose the same type of enhancement, creating less diverse societies (Kamm 2005). Whether positive or negative effects manifest in society as the result of human enhancement depends on how individuals exercise their freedom to engage in or abstain from enhancement.

Using medicine for an enhanced society

Technologies used for biomedical enhancement are couched in a medical context. From prostheses to pharmacology to types of neuro-stimulation, much of what we now refer to as enhancements have evolved from medical treatments. Enhancement and medicine seem so tightly intertwined that it has been suggested that “saying no to biomedical enhancement isn’t really an option— unless we want to stop medical progress” (Buchanan 2010). Whereas the means may develop in tandem, treatments and enhancements serve different ends. These terms are frequently used in an oppositional and exclusive manner such that a so-called enhancement is “designed to produce improvements in human form or function that do not respond to legitimate medical needs” (Juengst 1998). From this definition, it seems simple to untangle enhancement from treatment. In practice, this distinction is more difficult. For example, although professional guidance from the American Association of Clinical Endocrinologists clearly states that there is no evidence to support the use of human growth hormone for anti-aging or to enhance athletic performance, these two uses still account for approximately 30% of all prescriptions (Cook et al. 2009). This figure suggests that the drive to be at one’s very best using enhancement is prompting society, and with it medicine, to reconsider what it means to be healthy and functional.

Individuals seeking to be the best versions of themselves may perceive dysfunction and a remedy where medicine does not. From the medical perspective, enhancement leads to major concerns over (1) the expanding spectrum of medical needs and (2) the ends these needs serve.

The first worry is related to the process of "medicalization" (Conrad and Gabe 1999; Mbongue et al. 2005). Medicalization turns "natural expressions of human behavior into a 'disease' that requires – or would benefit from – drug treatment" (Flower 2004). At one extreme, medicalization has been associated with "disease mongering" (Moynihan, Heath, and Henry 2002) or a "diagnostic bracket creep" (Kramer 1997), i.e., a way of growing drug markets to sell and deliver treatments by creating new medical conditions. Thus, certain levels of human performance that, to date, have not been part of a diagnosis might become the target of treatment with medications based on redefined notions of normal human function – and dysfunction. Conversely, some also believe that medicalization has improved health over the years (Farah et al. 2004). The development of oral contraceptives, i.e., drugs that do not cure but prevent, has positively impacted family planning. Nonetheless, oral contraceptives are far from being considered human enhancement, and by no means would a woman taking them be considered inauthentic. The picture becomes less clear when other types of medicalization are considered. The increased non-medical use of prescription stimulants among university students has sparked a debate regarding whether more students have attention deficits or whether academic performance standards are too difficult to attain without medication (Rabiner et al. 2009). Aging populations have a host of products available to them to stave off age-related cognitive and physical decline, allowing them to age more actively and productively (George and Whitehouse 2011; Fries 2014) These two areas are examples of how the confusion between treatment and enhancement can make certain types of human activity prone to medicalization.

Serving social purposes or functions through medicine is the second major worry. Sadler and colleagues argue that medicalization "may represent a broad range of human interests and values, as well as serve one or more social purposes or functions" (Sadler et al. 2009). Indeed, changing the ideals of performance would qualify within these interests and social purposes, and certain examples of medicine serving society already exist. Parallels have been drawn between cognitive enhancement and cosmetic surgery, a procedure that can be used as a treatment for some and the fulfillment of a non-medical wish to have a certain appearance for others (Chatterjee 2004). These types of interventions have been grouped together as “wish-fulfilling medicine” (Buyx 2008; Asscher, Bolt, and Schermer 2012), with “doctors and other health professionals using medical means (medical technology, drugs, etc.) in a medical setting to fulfill the explicitly stated, prima facie non-medical wish of a patient” (Buyx 2008). There are two significant concerns regarding the emergence of the uses of medical technology for enhancement. The first is that wish-fulfilling medicine, particularly in the treatment of so-called lifestyle illnesses (e.g., obesity and smoking-related illnesses), “remove responsibility or control from the individual or society” (Gilbert, Walley, and New 2000). From this perspective, the use of enhancements can be a detriment to strategies that promote different aspects of public health because lifestyle choices would not pose the health hazard they once did. Becoming the best version of oneself represents a high level of human agency, but the medicalization of some aspects of a person may discount this agency, which is uniquely human.

Physicians are in a difficult position at the crossroads of treatment and enhancement. Simply because physicians “play a de facto role” in gatekeeping the technologies used for enhancement does not mean that this is the role they should be playing (Asscher, Bolt, and Schermer 2012). Some authors have argued that it is inappropriate for the medical profession to correct social injustices by helping individuals meet academic or professional performance expectations with enhancement technologies (Dees 2004; Forlini, Gauthier, and Racine 2013). However, recent guidance from the American Academy of Neurology (AAN) gives physicians a wide berth in deciding whether to grant patient requests for neuroenhancement (Larriviere et al. 2009). According to the AAN, neurologists are neither ethically obligated nor forbidden from prescribing medications for purposes of enhancement, which suggests that medicine is moving toward serving social purposes.

Whether human enhancement continues to influence medicine and other social institutions depends on the decisions of individuals. Many predict that widespread human enhancement is inevitable, but as long as humans are agents of free will, enhancement remains a choice. Medical technologies may make enhancement *possible* but do not necessarily mean that enhancement *should* be undertaken. Individuals and societies must continue to examine the appropriateness and ethics of using medical technology for individual enhancement to properly evaluate the potential outcomes.

References

Asscher, Eva C.A., and Maartje Schermer. 2012. "Wish-Fulfilling Medicine in Practice: a Qualitative Study of Physician Arguments." *Journal of Medical Ethics 38* (6): 327-31.

Buchanan, Allen. 2010. *Better Than Human: the Promise and Perils of Enhancing Ourselves*. Oxford: Oxford University Press.

Buyx, Alena M. 2008. "Be Careful What You Wish For? Theoretical and Ethical Aspects of Wish-Fulfilling Medicine." *Medicine, Health Care, & Philosophy 11* (2): 133-43.

Caplan, Arthur L. 2003. "Is Better Best? A Noted Ethicist Argues in Favor of Brain Enhancement." *Scientific American 289* (3): 104-5.

Chatterjee, Anjan. 2004. "Cosmetic Neurology: the Controversy over Enhancing Movement, Mentation, and Mood." *Neurology 63* (6): 968-74.

Conrad, Peter and Jonathan Gabe. 1999. "Introduction: Sociological Perspectives on the New Genetics: an Overview." *Sociology of Health & Illness 21* (5): 505-16.

Cook, David, Kevin Yuen, Beverly Biller, Stephen Kemp, and Mary Vance. 2009. “American Association of Clinical Endocrinologists Medical Guidelines for Clinical Practice for Growth Hormone Use in Growth Hormone-Deficient Adults and Transition Patients - 2009 Update.” *Endocrine Practice 15*(Supplement 2): 1-29.

Dees, Richard H. 2004. “Slippery Slopes, Wonder Drugs, and Cosmetic Neurology: the Neuroethics of Enhancement.” *Neurology 63* (6): 951-2.

Dees, Richard H. 2007. “Better Brains, Better Selves? The Ethics of Neuroenhancements.” *Kennedy Institute of Ethics Journal 17* (4): 371-95.

DeGrazia, David. 2000. “Prozac, Enhancement, and Self-Creation.” *Hastings Center Report 30* (2): 34-40.

Erler, Alexandre. 2011. “Does Memory Modification Threaten Our Authenticity?.” *Neuroethics 4* (3): 235-49.

Farah, Martha J., Judy Illes, Robert Cook-Deegan, Howard Gardner, Eric Kandel, Patricia King, and Eric Parens, Barbara Sahakian, and Paul Root Wolpe. 2004. “Neurocognitive Enhancement: What Can We Do and What Should We Do?.” *Nature Reviews. Neuroscience 5* (5): 421-5.

Fitz, Nicholas S., Roland Nadler, Praveena Manogaran, Eugene W.J. Chong, and Peter B. Reiner. 2014. “Public Attitudes Toward Cognitive Enhancement.” *Neuroethics 7* (2): 173–88.

Flower, Rod. 2004. “Lifestyle Drugs: Pharmacology and the Social Agenda.” *Trends in Pharmacological Sciences 25* (4): 182-5.

Forlini, Cynthia, Serge Gauthier, and Eric Racine. 2013. “Should Physicians Prescribe Cognitive Enhancers to Healthy Individuals?.” *Canadian Medical Association Journal 185* (12): 1047-50.

Forlini, Cynthia and Eric Racine. 2009. “Autonomy and Coercion in Academic “Cognitive Enhancement” Using Methylphenidate: Perspectives of Key Stakeholders.” *Neuroethics 2* (3) :163-77

Fries, Christopher J. 2014. “Older Adults' Use of Complementary and Alternative Medical Therapies to Resist Biomedicalization of Aging.” *Journal of Aging Studies 28*: 1-10.

George, Daniel R. and Peter J. Whitehouse. 2011. “Marketplace of Memory: What the Brain Fitness Technology Industry Says about Us and How We Can do Better.” *Gerontologist 51* (5): 590-6.

President's Council on Bioethics. 2003. *Beyond Therapy*. Washington, DC: President's Council on Bioethics/Harper Collins.

Gilbert, David, Tom Walley, and Bill New. 2000. "Lifestyle Medicines." *British Medical Journal 321* (7272): 1341-4.

Harris, John. 2007. *Enhancing Evolution: the Ethical Case for Making People Better*. Princeton: Princeton University Press.

Heilinger, Jan-Christoph and Katja Crone. 2014. "Human Freedom and Enhancement." *Medicine, Health Care, & Philosophy 17*(1):13-21.

Juengst, Eric. 1998. "What Does Enhancement Mean?." In *Enhancing Human Traits: Ethical and Social Implications*, ed. Erik Parens, 29-47. Washington, DC: Georgetown Univerity Press.

Kamm, Frances M. 2005. "Is There a Problem with Enhancement?" *American Journal of Bioethics 5* (3): 5-14.

Kass, Leon R. 2003. "Ageless Bodies, Happy Souls." *The New Atlantis* 1 (Spring): 9-28.

Kramer, Peter D. 1997. *Listening to Prozac*. London: Penguin Books.

Larriviere, Dan, Michael A. Williams, Matt Rizzo, and Richard J. Bonnie. 2009. "Responding to Requests from Adult Patients for Neuroenhancements: Guidance of the Ethics, Law and Humanities Committee." *Neurology 73* (17): 1406-12.

Levy, Neil. 2007. *Neuroethics: Challenges for the 21st Century*. Cambridge: Cambridge University Press.

Mbongue, T.B. Ngoundo, A. Sommet, A. Pathak, and J.L. Montastruc. 2005. ""Medicamentation" of Society, Non-Diseases and Non-Medications: a Point of View from Social Pharmacology."*European Journal of Clinical Pharmacology 61* (4): 309-13.

Moynihan, Ray, Iona Heath, and David Henry. 2002. "Selling Sickness: the Pharmaceutical Industry and Disease Mongering." *British Medical Journal 324* (7342): 886-891.

Rabiner, David L., Arthur D. Anastopoulos, E. Jane Costello, Rick H. Hoyle, Sean Esteban McCabe, and H. Scott Swartzwelder. 2009. "Motives and Perceived Consequences of Nonmedical ADHD Medication Use by College Students: Are Students Treating Themselves for Attention Problems?" *Journal of Attention Disorders 13* (3): 259-70.

Racine, Eric and Cynthia Forlini. 2009. "Expectations regarding Cognitive Enhancement Create Substantial Challenges." *Journal of Medical Ethics 35* (8): 469-70.

Riis, Jason, Joseph P. Simmons, and Geoffrey P. Goodwin. 2008. "Preferences for Enhancement Pharmaceuticals: the Reluctance to Enhance Fundamental Traits." *Journal of Consumer Research 35* (3): 495-508.

Roduit, Johann A.R., Holger Baumann, and Jan-Christoph Heilinger. 2013. "Human Enhancement and Perfection." *Journal of Medical Ethics 39* (10): 647-50.

Sadler, John Z., Fabrice Jotterand, Simon Craddock Lee, and Stephen Inrig. 2009. "Can Medicalization Be Good? Situating Medicalization within Bioethics." *Theoretical Medicine & Bioethics 30* (6): 411-25.

Sandel, Michael J. 2004. "The Case against Perfection: What's Wrong with Designer Children, Bionic Athletes, and Genetic Engineering." *Atlantic Monthly 292* (3): 50–4, 56.

Savulescu, Julian. 2006. "Justice, Fairness, and Enhancement." *Annals of the New York Academy of Sciences 1093*: 321-38.

Whitehouse, Peter J., Eric T. Juengst, Maxwell Mehlman, and Thomas H. Murray. 1997. "Enhancing Cognition in the Intellectually Intact." *Hastings Center Report 27* (3): 14-22.

Illustration 9 "A precautionary approach to neuroenhancement strategies" by N. Stepanova

Chapter 9: Crossing mind barriers – A precautionary approach to neuroenhancement strategies

Charles Dupras*, Linda Jäger, Nakita Frater, Despoina Goniotaki

"Man is not going to wait passively for millions of years before evolution offers him a better brain."

-Cornelius E. Giurgea

Scientific research on the brain has traditionally incorporated biochemical, electrophysiological and psychological methods to discern the molecular, electrical and behavioral bases of the brain's function. The main goal was – and remains – to understand brain physiology and pathology to prevent or treat diseases. To that end, a wide range of pharmaceutical drugs, brain stimulation technologies and even gene technologies have been developed. Ultimately, it is predicted that the applications developed from such technologies may extend well beyond therapy and participate in human neuroenhancement. In a futuristic perspective, some of the novel brain interventions developed in recent decades might even result in the engineering of "super-brains" that might, for example, possess pseudo-telepathic powers to remotely control machines or other humans. Thus, the cognitive abilities of our brains are a central preoccupation of "transhumanism" a concept coined by the biologist Julian Huxley in 1957 that describes how human capacities might be extended beyond what would be considered the "normal functioning" of body and mind (Bostrom 2005). Although such a scenario today resembles a view of the future in a science fiction novel, the potential of using emerging technologies to enhance human beings has already raised a panoply of concerns that stimulated scientific and socio-ethical debates.

The first part of this chapter explores traditional and modern strategies that enhance our cognition and our psychology (which we refer to as "neuroenhancement") and that range from substances as common as coffee to today's "smart drugs", brain stimulation technologies and genetic or epigenetic engineering. The second part of this chapter consists of a discussion of the risk-benefit perspective of neuroenhancement, with an emphasis on why implementing such innovations in our society can be ethically sensitive.

Drugs as enhancers

It seems that human beings have always searched for ways to render themselves "better" and "smarter". Broad-spectrum plant-derived natural compounds for increasing neuro-functioning – such as Ginseng, Passion Flower, Hippophae and coffee – have been a full part of medical practice in various cultures for centuries. The effectiveness of these neuro-enhancing herbs in improving concentration and alertness was confirmed from a scientific perspective many years ago, and they have come to be collectively known as "adaptogens" (Brekhman and Dardymov 1969). Adaptogens are both socially and ethically accepted across the globe, despite the fact that many of them, when misused, can have severe and harmful side effects.

With the emergence of modern science, we are able to isolate and purify natural substances – and synthesize new substances with neuro-enhancing properties. Stimulatory compounds that modulate perception, mood, consciousness, alertness and behavior include substances such as cocaine and amphetamines. Cocaine was first isolated in 1855 from the leaves of the coca plant and had become a frequently used stimulant in some countries, including the United States, by the beginning of the 20th century. For instance, it was used in the formulation of the early version of *Coca-Cola*. Amphetamines were chemically synthesized in 1927 and were initially used to treat asthma. Their stimulatory effect was soon noticed, and their use ranged from diet pills to anti-fatigue drugs, popular in treating narcolepsy and in lengthening the attention span of soldiers during World War II.

In the late 1960s, the potential for the abuse of amphetamines and cocaine was recognized, which fostered further research that aimed to replace both substances and that led to the development of the first generation of synthetic psychotropics, including neuroepileptics, antidepressants and anxiolytics. However, those psychotropics were soon abandoned due to their unpleasant side effects, and were replaced by second-generation drugs known as "smart drugs" or "nootropics" – from the Greek words *noos* (mind) and *trepein* (turn, change) (Giurgea 1972). Nootropics are a class of psychotropic drugs that affect learning ability, concentration and memory. They protect the brain from injuries (both physical and chemical) and have no sedative or toxic effects. The first nootropic drug, *Piracetam*, was synthesized in 1964 by Dr. Cornelius E. Giurgea with the intention of enhancing brain function (Giurgea 1982). By advocating that *"Man is not going to wait passively for millions of years before evolution offers him a better brain*", Giurgea paved the way for the development and increasing acceptance of neuro-enhancing drugs (Rose 2006).

Although "stimulants" are the most well-known nootropics, broad spectrums of substances are classified under the same term. This classification currently includes metabolic agents (e.g., creatine, carnitine), herbs and plant extracts (e.g., Bacopa Monnieri, St. John's Wort), dopaminergics (e.g., Modafinil, Ritalin, Adderall), nutrients (e.g., choline, creatine), eugeroics[19] (e.g., Modafinil, Adrafinil, Nuvigil) and racetams[20] (Garnock-Jones and Keating 2009; Sulzer

[19] Eugeroics are psychostimulants presumed to be effective only in cases in which 'normal' function is impaired.
[20] Racetams represent a broad-range of drugs, including some psychostimulants.

2005). Despite their usefulness in treating disorders such as narcolepsy, Alzheimer's and Parkinson's diseases, in addition to attention deficit hyperactivity disorder (ADHD), the mode of action of many nootropics remains elusive (Mondadori 1994; Mondadori 1993).

Substances such as the narcolepsy drug Modafinil (Provigil®) – also called "Brain Viagra" – were so effective that they became popular within certain work communities (for instance, night-shift workers and students) (McCabe 2005; Gerrard and Malcolm 2007). Even Hollywood has recognized their "usefulness" and expanded the possible scenarios of "future generation" drugs. Built on the urban myth that we commonly use only a small portion of our brain capacity, films such as *Limitless* (2011) or more recently *Lucy* (2014) have taken the possible effects of magic pills to an entirely new level. Both movies portray neuroenhancement as alluring, creating "super humans" with outstanding cognitive abilities. However, these movies also raise important socio-ethical issues, including the abuse of power in *Limitless* and the fear of losing what makes us human in *Lucy*.

Brain stimulation technology

Neuroenhancement strategies are not limited to "magic pills". Cutting-edge technology also includes both invasive and non-invasive brain-controlled machines. Until recently, the actual implementation of these technologies was considered too futuristic and/or beyond the scope of realistic deliberations into their possible applications. However, in the movie *Transcendence* (2014), Hollywood has recently picked up on scenarios that might arguably be possible, challenging our perception of where human beings end and machines begin.

The significance of this field, which aims at understanding the neural connectivity of the brain, is also highlighted in the array of consortiums and projects on the topic launched in recent years. Between 2012 and 2014, the *Human Connectome Project,* the *Human Brain Project and the BRAIN* initiative were launched. The objective of the first project is to provide a network map of the normal brain. The second project uses computer simulations to increase our understanding of brain function. Building on previous knowledge, the third and newest project aims at "accelerating the development and application of innovative technologies" related to the brain (Bargmann and Nesome 2014).

The non-invasive technologies used today are represented by "trans-cranial magnetic stimulation" and "trans-cranial direct current stimulation". They consist essentially of non-invasive techniques (electrodes on the scalp) that transmit small magnetic fields and electrical currents to specific regions of the brain to increase or decrease neuronal activity in the stimulated area. These techniques are used to treat psychiatric disorders, depression, post-traumatic stress disorder or schizophrenia, Parkinson's disease, and epilepsy (Rossi 2009). In addition to their therapeutic use, they have been shown to enhance cognition, selective attention (Gladwin, den Uyl, and Wiers 2012) and working memory (Fregni 2005). Other techniques, including "deep brain stimulation" and "neural prosthetics", involve technological implants inserted into the brain and are therefore more invasive. Deep brain stimulation requires the implantation of an electronic device into the brain in combination with medication to provide curative or palliative solutions to severe disorders, such as obsessive-compulsive disorder, Tourette syndrome, Alzheimer's or Parkinson's diseases (Rabins et al. 2009). The most promising methods may be the so-called "brain-machine interfaces" (BMI), which typically do not require deep surgical implantation into the brain. BMIs are based on brain activity recording techniques, such as electroencephalography

(EEG) and functional magnetic resonance imaging (fMRI). These interfaces are mainly used for brain-computer communication and, to date, have come to play an important role in neurological rehabilitation (Dalv and Wolpaw 2008).

One of the most mature – and largely known – brain stimulation technologies is the Cochlear implant, which transforms sound waves into electronic signals and stimulates the auditory nerve to transfer information into the brain. Various artificial retinas have also been developed. Typically, these are connected to a small external computer (an "exocortex") that processes the electronic information captured by the artificial retina and sends it to the visual cortex of the brain for detection. Further applications of the technology involve neural implants that relay voluntary motor signals to prosthetics or computers to correct movement disorders (Collinger 2013; Yanagisawa 2011).

During the last decade, the production of safer and more efficient brain implants, improved surgical procedures that render the insertion of deep brain stimulation devices reversible, and a number of successful therapeutic trials have fostered the potential to apply this type of technology, for example, to memory enhancement (Bell, Mathieu, and Racine 2009). Much like the "magic pills" are becoming the norm in certain communities, we anticipate similar success for these brain-stimulating technologies.

Genetic engineering

The interest in neuroenhancement through the use of "magic pills" or brain-machine interfaces is growing significantly. Nevertheless, as the pharmacological and technological interventions described above imply, these strategies have been developed to alter somatic and phenotypic traits, as opposed to germinal and genotypic traits. For this reason, they can typically only temporarily fix an abnormality, and frequent repetition of the treatment is often required. In other words, the neuroenhancement that is achieved by these means is not permanent over the long term and cannot be transmitted genetically to offspring.

When a permanent – and trans-heritable – neuroenhancement is intended, genetic engineering technology is necessary, at least for now and according to our best knowledge. The most recent decades of biological research have generated a large amount of information on the human genome that may indeed be of interest in developing more permanent neuroenhancement strategies in the future. The growing knowledge about the genes involved in human cognition has led to novel treatments to restore neurological functions to be tested in humans. For instance, one of the first successful (2011) gene therapy trials in neurobiology was the treatment and cure of choroideremia, which causes successive blindness in males from childhood to middle age (Benjaminy, Macdonald, and Bubela 2014). Moreover, the human gene named *rbAp48* was recently found to be involved in age-related memory loss (Pavlopoulos 2013). Notably, when this gene was knocked out in mice, the animals exhibited short-term memory loss, failing both novel object recognition tests and various maze experiments. When the gene was reintroduced, the mice could remember new objects better and find their way out of the mazes. Such genes are foreseen as future candidates for restoring or enhancing cognitive functions.

As a complement to genetic research, epigenetics – the study of how the environment influences the expression of our genetic background without inducing any changes in the DNA sequence – has also been shown to play a key role in neurological processes and behaviors. It has been observed that maternal interaction with offspring in rats might alter the expression of a specific gene in the offspring by modulating DNA methylation – a chemical reaction that occurs in DNA strands (Weaver 2004). Different levels of methylation in this specific gene were found to influence the animals' stress response in adulthood. Similar studies in humans have also revealed associations between early-life conditions (such as stress and social adversity) and the epigenetic programming of gene expression by DNA-reversible modifications that affect psychological health in adulthood (McGowan and Szyf 2010). These findings indicate that, by modifying the living conditions during embryogenesis, fetal development and early life – or by reversing the "epigenetic programming" that occurs through DNA-reversible modifications – we might have found novel opportunities to optimize one's future health.

Despite the documented efficiency of the abovementioned trials in treating rare neurological disorders, genetic and epigenetic engineering in humans remains in its infancy. However, the increasing knowledge regarding our genome, in combination with the array of novel genome editing techniques, offers hope for the development of strategies that may possibly reverse detrimental innate genetic traits or acquired epigenetic variations programmed by adverse early-life conditions. Given that these technologies appear to be effective for therapeutic purposes, they also hold great potential for enhancing cognitive abilities in the future.

Socio-ethical issues

With these advancements in neurobiology and the potential for neuroenhancement they entail, certain ethical and social issues are emerging. The first issue involves medical safety. It is commonly acknowledged that the clinical risks – unwanted side effects or unanticipated future outcomes to patients and research participants – must be minimized. The great complexity of the brain makes such interventions very sensitive. Before we implant an electronic device into someone’s brain, for instance, there should be no other alternative remaining, and the expected benefits should be significant and highly likely.

However a risk-benefit analysis that is grounded only in a clinical and therapeutic mindset may be insufficient in addressing the larger societal risks that we face with the appearance of a diversity of novel neuroenhancement opportunities in our lives. For instance, lowering the clinical risks of psycho-stimulants by developing smart drugs with only minimal side effects may simultaneously lower the threshold of benefits that are required for their acceptable implementation. Hence, the minimization of their clinical risks may lead to the trivialization of their use, which may lead to larger consequences for society, as we discuss below. For this reason, it is important to the subsequent regulation of their use to consider how these technologies can impact not only the health of individuals but also human life and the common good more generally.

For instance, privacy and confidentiality issues are emerging and should also be addressed. With the increasing number and performance of instruments related to brain imaging technologies (e.g., EEG, fMRI), there is a growing risk that the protection of one’s private life and personal information will be challenged. For example, mind reading devices and research that aims to read intentions or the thoughts of criminals is steadily gaining interest in the justice system as a supplementary tool to assess one’s liability in a crime. Similarly, military uses of mind-reading technology (for instance, taking information from someone without his consent for reasons of national security) might also represent a potential threat to privacy and confidentiality. Further tangible future applications include adapting advertisements to consumers’ preferences after reading their minds and gaining access to and taking advantage of health data and intimate thoughts. With the development of “mind transferring” technologies – in which “individual knowledge” can be stored in computers – strong concerns related to the storage, processing and manipulation of such “sensitive” information are being voiced. For instance, should employers or insurance companies have access to this information? Moreover, might such access lead to discrimination in social security or employment?

Additionally, issues related to individual autonomy and social justice might also arise. With the increasing use of nootropics to boost learning and memory capacity, we might enter into a “competition game” in which students and workers are asked to handle significantly more tasks based on their increased productivity and efficiency. Forecasting the future of previously existing trends, we may wonder whether the use of cognitive enhancers will remain a free choice. Indeed, there might be increasing pressure to take these drugs to perform, which may affect the free and voluntary decision-making process that should guide these actions. Further, if an increasing number of people use these drugs to boost their academic performance, we may wonder whether it is fair for the individuals who do not. If not everyone has access to cognitive enhancers, disparities in performance according to social status will likely be created and reinforced, further increasing the social gap between the rich and the poor. Hence, we might discuss the fairness of only certain people having the ability to enhance their human capacities, whereas others might not even have enough resources to reach their “normal” unenhanced human potential.

Further macroscopic economic issues are also at stake. Indeed, given that the healthcare system is already cracking under the insurmountable costs of therapeutic health services, is it reasonable to invest so much in developing neuro-technologies and to cover their non-therapeutic use with public funds when we – as a society – might not be able to afford it? In fact, doing so would lead not only to an undesirable extra financial burden on society but also (arguably) to another burden on the environment, given that the creation of these technologies requires substantial extra energy and materials, which are both limited resources. Inversely, the contemporary imperatives of a growing economy might be used as a rhetorical justification for increasing the required amount of productivity from individuals (e.g., workers, students) by elevating their cognitive potential. However, such a race for competition and productivity is endless. Is this how we want to live? We must be aware of both the economic constraints and the pressures of the economic model we have chosen if we aim for the ethical implementation of neuro-enhancers in our society.

With the mapping of the human brain and its connection to machines, we might increasingly perceive ourselves in mechanistic terms as being highly determined by our body, which these technologies can always "upgrade". Following such a perspective, according to which all human behaviors may be explained by neurotransmitters and localized brain activity, which in turn might be subject to modulation to "improve" behavior, we might wonder whether concepts such as merit, motivation, courage and, above all, free will will continue to have the same value. In this context, what place would remain for individual choice and how might it modify the lived human experience? Moreover, increasingly perceiving ourselves as mere biologically determined 'automated machines' – i.e., not influenced by God or any external spirit – we may well reconsider what place religion and more generally spirituality will hold in our societies.

In sum, critical questions emerge. Do we want privacy and confidentiality to remain important values in the future? Can we accept that our lives might be ruled by the pressure of an endlessly growing economy that keeps asking for more and more from each individual? How do we anticipate or expect to change? Will it be a bodily or a spiritual change? Will we remain 'free creatures'? Adopting a precautionary approach to the implementation of neuroenhancement technology and finding answers to such questions is essential to appropriately prepare for its effect on our human and cultural identity and on what we think of and how we interact with other people.

References

Bargmann, Cornelia I. and William T. Nesome. 2014. “The Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative and Neurology.” *JAMA Neurology* 71 (6): 675-6.

Bell, Emily, Ghislaine Mathieu, and Eric Racine. 2009. “Preparing the Ethical Future of Deep Brain Stimulation.” *Surgical Neurology* 72 (6): 577-86 [Discussion:586].

Benjaminy, Shelly, Ian Macdonald, and Tania Bubela. 2014. “"Is a cure in my sight?" Multi-Stakeholder Perspectives on Phase I choroideremia Gene Transfer Clinical Trials.” *Genetics in Medicine : Official Journal of the American College of Medical Genetics* 16 (5): 379-85.

Bostrom, Nick. 2005. “In Defense of Posthuman Dignity.” *Bioethics* 19 (3): 202-14.

Brekhman, I.I. and I.V. Dardymov. 1969. “New Substances of Plant Origin Which Increase Nonspecific Resistance.” *Annual Review of Pharmacology* 9 (1): 419-30.

Collinger, Jennifer L., Brian Wodlinger, John E. Downey, Wei Wang, Elizabeth C. Tyler-Kabara, Douglas J. Weber, Angus J. C. McMorland, Meel Velliste, Michael L. Boninger, and Andrew B. Schwartz. 2013. “High-Performance Neuroprosthetic Control by an Individual with Tetraplegia.” *Lancet* 381 (9866): 557-64.

Daly, Janis J. and Jonathan R. Wolpaw. 2008. “Brain-Computer Interfaces in Neurological Rehabilitation.” *Lancet Neurology* 7 (11): 1032-43.

Fregni, , Paulo S. Boggio, Michael Nitsche, Felix Bermpohl, Andrea Antal, Eva Feredoes, Marco A. Marcolin, Sergio P. Rigonatti, Maria T. A. Silva, Walter Paulus, and Alvaro Pascual-Leone. 2005. “Anodal Transcranial Direct Current Stimulation of Prefrontal Cortex Enhances Working Memory.” *Experimental Brain Research* 166 (1): 23-30.

Garnock-Jones, Karly P. and Gillian M. Keating. 2009. "Atomoxetine: A Review of Its Use in Attention-Deficit Hyperactivity Disorder in Children and Adolescents." *Paediatric Drugs* 11(3): 203-26.

Gerrard, Paul and Robert Malcolm. 2007. "Mechanisms of modafinil: A Review of Current Research." *Neuropsychiatric Disease & Treatment* 3 (3): 349-64.

Giurgea, Corneliu E. 1972. "[Pharmacology of integrative activity of the brain. Attempt at nootropic concept in psychopharmacology]."*Actualites Pharmacologiques* 25: 115-56.

Giurgea, Corneliu E. 1982. "The Nootropic Concept and Its Prospective Implications." *Drug Development Research* 2 (5): 441–6.

Gladwin, Thomas E., Tess E. den Uyl, and Reinout W. Wiers. 2012. "Anodal tDCS of Dorsolateral Prefontal Cortex during an Implicit Association Test." *Neuroscience Letters* 517 (2): 82-6.

McCabe, Sean Esteban, John R. Knight, Christian J. Teter, and Henry Wechsler. 2005. "Non-Medical Use of Prescription Stimulants among US College Students: Prevalence and Correlates from a National Survey." *Addiction* 100 (1): 96-106.

McGowan, Patrick O. and Moshe Szyf. 2010. "The Epigenetics of Social Adversity in Early Life: Implications for Mental Health Outcomes." *Neurobiology of Disease* 39 (1): 66-72.

Mondadori, Cesare. 1993. "The Pharmacology of the Nootropics; New Insights and New Questions." *Behavioural Brain Research* 59 (1-2): 1-9.

Mondadori, Cesare. 1994. "In Search of the Mechanism of Action of the Nootropics: New Insights and Potential Clinical Implications." *Life Sciences* 55 (25-26): 2171-8.

Pavlopoulos, Elias, Sidonie Jones, Stylianos Kosmidis, Maggie Close, Carla Kim, Olga Kovalerchik, Scott A. Small, and Eric R. Kandel. 2013. "Molecular Mechanism for Age-Related

Memory Loss: the Histone-Binding Protein RbAp48." *Science Translational Medicine* 5 (200): 200ra115.

Rabins, Peter, Brian S. Appleby, Jason Brandt, Mahlon R. DeLong, Laura B. Dunn, Loes Gabriëls, Benjamin D. Greenberg, Suzanne N. Haber, Paul E. Holtzheimer, Zoltan Mari, Helen S. Mayberg, Evelyn McCann, Sallie P. Mink, Steven Rasmussen, Thomas E. Schlaepfer, Dorothy E. Vawter, Jerrold L. Vitek, John Walkup, and Debra J. H. Mathews. 2009. "Scientific and Ethical Issues Related to Deep Brain Stimulation for Disorders of Mood, Behavior, and Thought." *Archives of General Psychiatry* 66 (9): 931-7.

Rose, Steven. 2006. *The Future of the Brain: the Promise and Perils of Tomorrow's Neuroscience*. Oxford: Oxford University Press.

Rossi, Simone, Mark Hallett, Paolo M. Rossini, Alvaro Pascual-Leone, and The Safety of TMS Consensus Group. 2009. "Safety, Ethical Considerations, and Application Guidelines for the Use of Transcranial Magnetic Stimulation in Clinical Practice and Research." *Clinical Neurophysiology* 120 (12): 2008-39.

Sulzer, David, Mark S. Sonders, Nathan W. Poulsen, and Aurelio Galli. 2005. "Mechanisms of Neurotransmitter Release by Amphetamines: A Review." *Progress in Neurobiology* 75 (6): 406-33.

Weaver, Ian CG., Nadia Cervoni, Frances A. Champagne, Ana C. D'Alessio, Shakti Sharma, Jonathan R. Seckl, Sergiy Dymov, Moshe Szyf, and Michael J. Meaney. 2004. "Epigenetic Programming by Maternal Behavior." *Nature Neuroscience* 7 (8): 847-54.

Yanagisawa, Takufumi, Masayuki Hirata, Youichi Saitoh, Tetsu Goto, Haruhiko Kishima, Ryohei Fukuma, Hiroshi Yokoi, Yukiyasu Kamitani, and Toshiki Yoshimine. 2011. "Real-Time Control of a Prosthetic Hand Using Human electrocorticography Signals." *Journal of Neurosurgery* 114 (6): 1715-22.