A critical analysis of human improvement projects from the perspective of the self-organization theory

Mariana C. Broens[1]

Abstract: Based on the theory of self-organization, the objective of this paper is to critically discuss the theses defended by the postulators of two projects that aim to improve human nature: eugenics and transhumanism. We will try to show that the "science of eugenics", proposed by Francis Galton (1883), and the contemporary transhumanist project, outlined since the second half of the 20th century, share the controversial belief that human beings, through science and technology, are able to successfully control the evolutionary processes of human species. We will try to show that this belief disregards the central characteristics of the complex self-organized adaptive evolutionary processes of organisms in general. For this purpose, we will critically analyse the central theses of the transhumanist project and the "*status quo* bias" argument proposed by Bolton and Ord (2006) in defence of such theses. We conclude by emphasizing that the proponents of the contemporary transhumanist project would benefit from a fallibilistic perspective that would allow them to face the project's social and ethical possible implications with epistemic prudence.

Keywords: Eugenics; Transhumanism; Self-Organization; Evolution; Complex systems; Fallibilism; Ethics.

1. Introduction

In the middle of the 19th century, the question of how to improve human nature becomes particularly relevant. Francis Galton proposes the study of human eugenics: "[…] that is, of the conditions under which men of a high type are produced" (1883/2001, p. 30). Galton initiates a debate in the United Kingdom on how to enhance the human species by preserving and promoting "desirable" biological and cultural traits. He carried out statistical and demographic studies which pointed out strategies for population control – for example, on the correlation between the age at which women married and the birth rate presented by different age groups (1883/2001, p. 206-10). These strategies would allow "meritorious families", in Galton's words, to procreate in order to populate territories then occupied by people supposedly not deserving to do so. According to Galton: "The *most merciful* form of what I ventured to call 'eugenics' would consist in

[1] Faculty of Philosophy and Sciences, UNESP. Supported by CNPq and FAPESP.

watching for the indications of superior strains or races, and in so favouring them that their progeny shall outnumber and gradually replace that of the old one" (1883/2001, p. 199-200, emphasis added)[2].

At the time the eugenic project was proposed, there were in the United Kingdom great interest on the Malthusian population theory (Malthus, 1798) and the possible lack of natural resources to feed a world population whose number was increasing in a geometric progression (this theory is currently disproved thanks to various contemporary food production techniques). In addition, a misinterpretation (also ideologically committed to social prejudices) of the theory of evolution proposed by Darwin considered that altruistic and charitable social practices interfered in the process of naturally selecting the biologically and socially best fit human individuals, leaving aside the central role that altruistic practices actually played in human evolution, as Darwin himself points out in his book *Descent of man* (1874).

Some British intellectuals, such as H. G. Wells, George Bernard Shaw, Winston Churchill, Marie Stopes and Bertrand Russell (Brignell, 2010), have enthusiastically joined some mild versions of the eugenic project; others realized the possible scope of the project and its serious ethical implications. Gilbert K. Chesterton, for instance, published a work with the suggestive title *Eugenics and other Evils*, in which he argues that the eugenic project benefited from the ambiguity of the eugenics concept itself, since such a concept meant from a supposedly beneficial incentive to control the birth rate (allegedly high in the popular classes and low in the elites) to the implementation of aggressive public policies of confinement, forced sterilization or even extermination of people considered socially undesirable or "feeble-minded".

[2] Another important defender of the eugenic project was Ronald Fisher, one of the formulators of evolutionary genetics (Wade, 2008). As Daniel Kevles indicates in his studies of eugenics, Fisher asked, for example, the following question providing a controversial answer: "What reduction would the sterilization or segregation of all the 'feebleminded' produce in one generation?". Proceeding from a polygenic model of mental deficiency and being aware that the feebleminded did not tend to mate randomly but with assortativity – that is, with each other –, Fisher calculated that the segregation or sterilization of the feebleminded of one generation would yield a thirty-six percent reduction of incidence. This was, he asserted, "[…] of a magnitude which no one with a care for his country's future can afford to ignore" (1986, p. 165). In addition, Fisher's stance on alleged human racial differences is well known: when a UNESCO document was drafted in 1950 denouncing the mythical and pseudo-scientific character of the concept of human race underlying the eugenic project, Fisher objects by stating that human groups differ profoundly "[…] in their innate capacity for intellectual and emotional development […] [and] the practical international problem is that of learning to share the resources of this planet amicably with *persons of materially different nature*, and that this problem is being obscured by entirely well intentioned efforts to minimize the real differences that exist" (UNESCO, 1952, emphasis added).

In summary, the eugenic project is born and flourishes in the UK intellectual circles, and spreads across Europe and America at a time that combined great scientific and technological development, profound social changes (Soloway, 1984), and generalized uncertainties about the future of humanity due to the possible lack of natural resources.

Thus, it is not surprising that, given contemporary social, ecological and technological conditions and its possible (positive and negative) implications, might be insightful to draw a parallel between the historical/epistemic conditions in which eugenics and trans/posthumanism were proposed to improve the human species. This parallel between them seems legitimate particularly because they share assumptions, as we will try to emphasize. Nor is it surprising that interest in trans/posthumanism proliferates today in English and European intellectual circles and, as it has happened with the eugenic project itself, that heated debates in academic circles around the world are going on.

To critically analyse the theoretical principles of trans/posthumanism and to point out possible ethical implications of its widespread adoption, in this paper we will present, initially, the central assumptions of the trans/posthumanist project and,then investigate it from the perspective of the theory of self-organization, mainly with regard to its role in evolutionary processes.

2. Central theses of the human enhancement projects

The concept of transhumanism was coined in 1957 by Julian Huxley, a British evolutionary biologist and prominent member of the British Eugenics Society, being its vice president from 1937 to 1944 – from the consolidation of Nazism to almost the end of World War II – and its president between 1959 and 1962 – when Nazi programs of eugenic racism and the mass unconsented sterilization policies promoted in Finland, Japan, USA, Canada, Sweden, among others, were already well known (Wolf, 2014). In his book *New bottles for new wine*, Huxley points out:

> The human species can, if it wishes, transcend itself — not just sporadically, an individual here in one way, an individual there in another way, but in its entirety, as humanity. We need a name for this new belief. Perhaps *transhumanism* will serve: Man, remaining man, but transcending himself, by realizing new possibilities of and for his human nature (1957, p. 17, emphasis added).

In Huxley's project of human transcendence, science and technology play a central role in overcoming "natural barriers" faced by human species, among which the cure of diseases and the prolongation of life are considered the most relevant. For Huxley, human skills of directing actions with a purpose, as well as humans' self-awareness and awareness of the world and the capability of controlling natural processes through knowledge, gave us an additional ability: to control and direct our own evolutionary processes. As Huxley points out:

> The new understanding of the universe has come about through the new knowledge amassed in the last hundred years […]. It has defined man's responsibility and destiny—to be an agent for the rest of the world in the job of realizing its inherent potentialities as fully as possible. It is as if man had been suddenly appointed managing director of the biggest business of all, the business of evolution […]. What is more, he can't refuse the job. Whether he wants to or not, whether he is conscious of what he is doing or not, he *is* in point of fact determining the future direction of evolution on this earth (1957, p. 13-14, author's emphasis).

The human transcendence project of improving natural processes to, supposedly, overcome human suffering and deficiencies might seem justified and benevolent to their defenders. However, it may also have a dark side, like the ideas Huxley advocated in his work *Man in a modern world*, published in 1941. In this book, he stresses that:

> The lowest strata, allegedly less well-endowed genetically, are reproducing relatively too fast. Therefore birth-control methods must be taught them; *they must not have too easy access to relief or hospital treatment lest the removal of the last check on natural selection should make it too easy for children to be produced or to survive*; long unemployment should be a ground for sterilization, or at least relief should be contingent upon no further children being brought into the world; and so on. That is to say, much of our eugenic programme will be curative and remedial merely, instead of preventive and constructive (Huxley, 1941, p. 42, emphasis added).

In spite of that, Huxley is adamant in pointing out the relevance of both, social/cultural environment and biological characteristics of individuals, to improve human nature. In consequence, even with an elitist perspective of popular classes, according to him, favourable environmental conditions would allow destitute individuals to improve their cognitive skills and moral conduct. In this sense, one of the main methodological strategies adopted by the first human improvement studies was the classical genetics investigation of family pedigree, which combined the inclusion of

hereditary and socioenvironmental factors, as they allowed to consider clearly hereditary factors in family nuclei and the possible influence of social environment on them.

In this first face of transhumanism, although theoretically diffuse, some of its central assumptions can be clarified: (1) transhumanism establishes a new way of thinking human beings as a whole (not just the upper classes) and their role in the world, constituting "a new system of ideas" (Huxley, 1957 , p. 256); (2) it provides basis for establishing dialogues with evolutionary biology, but considers that human knowledge can replace and improve spontaneous dynamics of adaptive processes; (3) in consequence, according to the transhumanist perspective, human nature can be artificially transformed and improved through new technologies at a much faster rate and in different ways than the ones that could occur naturally.

The main assumptions presented above show that Huxley and other members of the human condition improvement project incorporated the new discoveries of geneticists from the 1950s and seemed to have learned some lessons from the various attempts at racial/social improvement already implemented, especially those related to prejudices contaminating scientific research. However, there seems to be a certain theoretical overlap between the theses of those adhering to the adoption of eugenic policies and the formulators of the new project to improve human condition, especially with regard to the hereditary character of mental illnesses, as pointed out by Pauline Mazumdar:

> The virus has mutated, and we are not as well immunised as we thought. The emergence of what many now see as new eugenics points up for us even more clearly the exquisitely close relationship between human genetics and eugenics that was evident in the struggles of the thirties. The critics of eugenics did not manage to give us human genetics that would create no victims. […] With more powerful methods, more concrete results began to come, and they no longer appeared to be as harmless as before. The projects that seemed in the thirties to represent a truly value-free science, by contrast with the cruder social biases of the eugenists, have come in the nineties to stand for the possibility of a new eugenics (1992, p.191-102).

The formulators and supporters of the contemporary version of transhumanism, in addition to adopting the presuppositions mentioned above in its dialogue with evolutionary biology, now consider Artificial Intelligence, Biotechnology, Nanotechnology, Biochemistry, and Genetics among the sciences capable of collaborating with the human enhancement project. As a result of this dialogue between biologists, computer scientists, philosophers, mathematicians, statisticians, biochemists,

information scientists, among others, the Transhumanist Declaration was drafted in 1998, and it's being constantly improved and updated.

The guiding principles of the Transhumanist Declaration are, briefly: (1) humanity will be profoundly affected by science and technology in the future, which will allow to expand human capabilities; (2) transhumanists believe that humanity has many potentialities, of which realization will allow extraordinary and valuable transformations; (3) however, they recognize that the use of new technologies is risky and can also have harmful consequences; (4) therefore, they consider that every effort should be made to assess such risks and avoid them, especially through forums of experts who discuss the emergent problems and seek solutions; (5) the reduction of risks, the preservation of life and the fight against suffering, the improvement of forecasting human ability and wisdom must be supported; (6) the creation of improvement policies must be guided by a moral and responsible perspective, which privileges individual rights, solidary practices and the dignity of the populations; (7) the welfare of all sentient beings, whether human beings, non-human animals or artificial systems, must be prioritized; (8) individuals who choose to improve their lives using the available technologies should be allowed to do so (Humanity +, 1998).

Especially, from the transhumanist perspective, policy making:

> […] ought to be guided by responsible and inclusive moral vision, taking seriously both opportunities and risks, respecting autonomy and individual rights, and showing solidarity with and concern for the interests and dignity of all people around the globe (Transhumanist Declaration, p. 1)

However, both democratic and authoritarian societies allow profound social differences that might be accentuated if improvement technologies are adopted. This possibility arises due to the difficulty of access to such technologies for the popular classes, the majority of the world population. As Holm emphasizes (1994):

> If genetic engineering is used to produce 'better' people (in the non-moral sense), then it is of very great importance how the benefits of such engineering are distributed. If enhancing genetic engineering will widen the already existing differentials in health status between different social classes or broaden the global North-South divide, then there might be reasons to reject it on the grounds of justice (p. 49-50).

Even allowing many criticisms, as the one presented above, such principles incorporated important ethical concepts distinct from those openly adopted by the first eugenicists, for whom social reform initiatives for the benefit of the privileged classes were "natural and correct". For example, contemporary transhumanists state the moral obligation to anticipate and predict the risks of using new technologies for human improvement, respect individual autonomy and social dignity and they acclaim solidarity and wisdom. They also seem to be aware of the myth of science's neutrality and the epistemological and ethical threats of dealing with prejudices and biases in scientific research. But they seem to share at least one key assumption with the various human improvement projects since the first theses on eugenics proposed by Francis Galton: the belief that the advancement of human knowledge and the development of new technologies will allow humanity to conduct its own evolutionary processes more successfully and faster than the process of natural selection itself.

Nick Bostrom and Toby Ord (2006) point out in their paper "The Reversal Test: Eliminating Status Quo Bias in Applied Ethics" that critics of the transhumanist project, such as Søren Holm (1994), Francis Fukuyama (2002), and Leon Kass (2002), may be influenced by prejudices against radical changes in the current evolutionary *status quo* of the human species, like those resulting from the widespread implementation of genetic engineering in future generations. According to Bostrom and Ord, one way to identify whether the criticisms stem from good arguments or from the *status quo* bias is to promote the Reversal Test:

> When a proposal to change a certain parameter is thought to have bad overall consequences, consider a change to the same parameter in the opposite direction. If this is also thought to have bad overall consequences, then the onus is on those who reach these conclusions to explain why our position cannot be improved through changes to this parameter. If they are unable to do so, then we have reason to suspect that they suffer from status quo bias (Bostrom and Ord, 2006, p. 664-665).

For example, let us consider that the parameter to be improved is the human capacity for moral judgment. As proposed by these authors (2006), if the *deterioration* of the human capacity for moral judgment, which would be the "opposite direction" of the same parameter, is considered socially harmful, then refusing the beneficial character of improving the human capacity to make moral judgments can only be considered

mistaken. Therefore, criticisms of promoting such improvement stem from the *status quo* bias.

We consider that the proposed test is based on at least two mistaken assumptions (which generate two intertwined problems) that we will address in the next part: (1) human beings, like other living beings, cannot be reduced to a set of isolated parameters and, (2) according to the evolutionary theory, the emergence of the human species, like any other one, results from long-term complex evolutionary processes, which involve, among other processes, natural selection trough adaptive capacities. We will emphasize that these capacities, according to Kauffman (1993) and Mitchell and Newman (2001), include co-evolutionary and random aspects resulting from long-term self-organized interactions in a dynamic environment. These aspects are so entangled that they make it very difficult to create adequate models to predict the possible implications of their modification, even the most immediate ones (Batty and Torrence, 2001).

3. Self-organization and evolutionary processes in complex systems

As Melanie Mitchell and Mark Newman (2001, p. 1) state in the text *Complex systems theory and evolution*, a complex system can be characterized as:

> […] a group or organization which is made up of many interacting parts. […] In such systems the individual parts—called "components" or "agents"— and the interactions between them often lead to large-scale behaviours which are not easily predicted from a knowledge only of the behaviour of the individual agents. Such collective effects are called "emergent" behaviours.

Thus, a complex system results from the interactions of a significant number of elements that establish relationships of co-dependency. When these relationships are strengthened and multiplied, the system becomes more complex, acquiring emerging properties that are difficult to foresee, as these properties belong to the system, not to its elements. For example, it is said that a human being, a living complex system, can be kind, vindictive, altruistic or resentful, and such properties are attributed to the person, not to his/her arm, his/her liver or even his/her brain. Examples of complex systems are ecosystems, organisms, global climate, social phenomena, metabolic networks, immune system, among many others.

A central feature of complex systems, that is going to be emphasized here, is their ability to self-organization, without the interference of an external element that controls

it. Debrun (1996) points out that self-organizing systems initiate a form of organization that was not previously determined by the initial conditions of its constituent elements. For Debrun:

> There is self-organization every time that, from an encounter between really (and not just analytically) distinct elements, an interaction among them arise […] that eventually leads to the constitution of a 'form' [primary self-organization] or to restructuring a pre-existing form by 'complexification' [secondary self-organization] (1996, p. 13).

In his paper "Principles of the self-organizing systems", William R. Ashby points out that the concept of organization is ambiguous, but that there is a central aspect that must be remembered, namely, its conditionality: "As soon as the relationship between two entities **A** and **B** becomes a conditioning factor in the value or state of **C** so a necessary component of 'organization' is present "(Ashby, 1962/2004, p. 103-4). The conditioning factor refers to the relations of co-dependency among the elements that constitute the system. Especially regarding organizations of living systems, the conditionality of their organization is associated with a field of possibilities, and only part of them is updated (mainly by adaptive process and natural selection).

Ashby points out that this way of approaching self-organized processes makes it evident that the organization is somehow associated with communication: "[...] we should define parts as being organized when 'communication' (in some generalized sense) occurs between them" (Ashby,1962 / 2004, p. 105). In this sense, organization is not the result of the intervention of a specific element that allegedly plays the role of unifying the parts, as defended by creationists and traditional approaches in biology. Such approaches consider that the organization of a system is an additional element, something added to its other elements that preserves its stability (as if it was a kind of ontological "glue" that kept together the constituent parts of the system).

Contrary to this conception, Ashby points out that the organization between A and B might involve some strong relation between what happens to A and what happens to B; if nothing that happens to A affects what happens to B, there is no organization between them. Communication is expressed in informational relationships that establish constraints conditioning the interactions of the system's elements. The informational interaction between the elements of the system may involve, for example, electrochemical

exchanges or natural languages, depending on the scale and the nature of the systems and its elements.

While the elements of the organization start their interactions, constraints are gradually established in the possibilities of the individual action of each element through feedback processes and the system gradually forms its own identity. Secondary self-organization occurs. According to Debrun (1996), a dynamically stable system, human beings, for instance, becomes more complex mainly by learning. The equilibrium of the system involves adjustments of its elements to preserve the delicate balance between maintaining the existing form and the possible assimilation of novelties: both the assimilation of novelties in excess and the lack of novelties can cause the system to collapse. As Debrun points out:

> Within an organism or an already consolidated community, by definition, there cannot be great heterogeneities, since interior relations prevail between the elements (which are, therefore, semi-distinct). Even so, an internal creation is possible and, this time, it will be embodied in an interaction / collaboration, and not in an interaction / competition (1996, p. 15).

The most fundamental characteristic of secondary self-organization would be, according to Debrun (1996, p. 51), "the work of oneself on oneself" in the restructuring of the individuals' organization. One example of this type of self-restructuring are human beings. We instantiate genuine secondary self-organization, for example, when we acquire new information that helps us to improve our moral judgment.

Let us consider that example, which would be a secondarily self-organized skill, according to the theory of self-organization. From the complex systems perspective, we can realize that the ability to formulate moral judgments is an emergent property of human beings, fundamental to their social interactions. Although no one knows how human beings perform moral judgments, there is strong evidence that they involve rational deliberations and emotional aspects (such as compassion, loyalty, resentment, generosity, among many others). We also ignore what emotions consist of, but there are significant indications that emotional states are closely linked to bodily processes, involving the cardiovascular, skeletomuscular, neuroendocrine, and autonomic nervous systems, continuously in biochemical communication with each other, as pointed out by Nummenmaa et al. (2014). For example, the blush of shame, the cry of sadness, the heartbeat of fear.

If we ignore the nature of cognitive and emotional processes, in order to improve the human capacity to moral judgments, we face a first, but not trivial, difficulty: lacking a "science of the mind" (if the mentalistic vocabulary can still be used) that effectively allows enhancing cognitive, emotional and perceptual human skills. In addition, we face a second difficulty, also relevant, related to the integrated relations of co-dependency between the elements of various scales that make up the human organism, from the micro scales of the neuroendocrine system to the macro scales of the expression of moral judgments in social interactions.

How to anticipate consequences and assess the risks of altering elements in this organization of multiple scales of integrated, co-dependent, relationships? How can we know if the attempt to improve a single human capacity, that of formulating moral judgments, will not interfere with the delicate and fragile balance of the human organism as a whole, causing it to collapse due to the impact of this single novelty in the system? This last question acquires relevance when we consider that human cognitive, emotional and perceptual capacities resulted from a very long evolutionary trajectory involving self-organized adaptive and selective processes[3].

Even if, as Mitchell and Newmann (2001) point out, the complex systems theory contributes with evolutionary studies promoting the creation of mathematical models that allow to understand emergent behaviours, as is the case of human cognitive and emotional capacities, these models, nevertheless, face limits and huge difficulties. As Batty & Torrence (2001, p. 1) state:

> A working definition of a complex system is that of an entity which is coherent in some recognizable way but whose elements, interactions, and dynamics generate structures admitting surprise and novelty which cannot be defined. Complex systems are therefore more than the sum of their parts, and a consequence of this is that any model of their structure is necessarily incomplete and partial. Models represent simplifications of a system in which salient parts and processes are simulated and given this definition, many models will exist for any particular complex system,

[3] Comparative studies on the evolutionary history of organisms have highlighted the role that cognitive capacities have been offering to various species in their ecological interactions: in the search for food, in social relationships, in self-defence etc. (Heyes & Huber, 2000). Furthermore, leaving aside the pseudo dichotomy "nature *versus* culture", committed to dualistic ontologies, contemporary Ethology studies have revealed that several species of non-human animals show altruistic behaviours, involving empathy and comfort in adversity, cooperation for problem solving, self-sacrifice, among others (Kropotnik, 1902; de Waal, 2000; de Waal, 2010; Joyce, 2006). Thus, the evolutionary nature of moral conduct, and of moral deliberation, seems to be clearer.

Let us assume, for the sake of argument, that it is possible to create several mathematical models that would allow to understand and predict implications and risks of improving solely the human capacity to make moral judgments. How can the models be validated? Would they be tested in humans?

These are some of the difficulties faced by transhumanist proposals to improve the human condition when focused from the theory of self-organization of complex systems, whose possible ethical implications will be commented below.

4. Final comments

In this paper, we initially presented historical data on the eugenic project proposed by Francis Galton at the end of the 19th century. Such a project promised to implement public policies based on statistical and demographic studies to "improve" the quality of future generations of the English population, especially through forms of population control. As we have seen, the eugenic project attracted the interest of important intellectuals of the time, concerned about the food shortage scenario outlined by Thomas Malthus and about the social problems related to poverty and inequality resulting from industrial revolution and its long-term implications.

We also indicate that, (1) given that the contemporary social, ecological and technical-scientific conditions in which the transhumanist project is being outlined are similar to the conditions in which the eugenic project was conceived, and (2) because both share the central thesis that humanity can take the reins of its own evolution, it may be relevant (3) to draw a parallel between the two projects and, enlightened by the implications of the first one, which are already known, try to foresee the possible consequences of the second. In this way, the parallel can be especially relevant to reflect on the possible ethical implications of the transhumanist project in societies characterized by deep inequalities.

Thus, from an ethical perspective, we have to consider that this project tends to deepen the inequalities between popular classes and elites, even in democratic societies, since access to improvement technologies, basically due to financial reasons, will be out of reach for the majority of the world population, and this tendency is likely to increase.

Then, we argued that the theory of self-organization of complex systems can help us understand the underlying problems in projects that defend the improvement of human

species. In the light of this theory, we emphasized that, due to the complexity of organisms in general, living systems whose component elements are interrelated and in constant communication with each other, highly integrated and co-dependent, it is at least reckless to implement changes using genetic, pharmaceutical or computational technologies, whose immediate and long-term implications are very difficult to predict, even using sophisticated mathematical models.

The postulators of the contemporary transhumanist project state that their aim is the effective human improvement and the general good, unlike previous eugenic enhancement projects that intended to privilege a single social class or ethnic group. Furthermore, we recognize that, in certain cases, demographic policy or the use of genetic engineering seems ethically legitimate, for example, in the case of people affected by haemophilia. In this type of case, the ethical dilemmas are quite evident, and there are no solutions that do not put some moral value at stake.

However, the transhumanist defenders seem to present an overwhelming and fundamental epistemic problem that is also an ethical one: it depends on a deep confidence in the actual contributions of science and technologies to effectively enhance human nature the way they expect. This confidence seems to depend, in turn, on a conception of science and technology that does not adopt a fallibilistic perspective embraced by the scientific community. The adoption of such a perspective allows to promote continuous revisions in scientific postulates and methodologies from a constant dialogue with reality (including social, economic and political ones). We believe that this confidence in scientific and technological development to improve human beings is mistaken also because it underestimates possible social, political and ethical impacts of the almost uncontrollable economic interests associated with such a project.

We conclude by pointing out that there is a profound difference between using science and technology to minimize human suffering (especially when caused by illness and disability) and using it to supposedly improve human capabilities. In both cases, there are risks that possibly exceed our ability to predict, but, in the first one, it may be ethically correct to take certain risks to attenuate suffering, while it may not occur in the second.

Furthermore, possibly much suffering could have been avoided, and might be avoid in the future, if the ideal of human improvement had been studied from a fallibilistic perspective. If adopted by the developers of new technologies and public policy makers, the fallibilistic perspective, added to the theory of self-organization, might allow them to foresee the ethical dilemmas that this project might raise with epistemic prudence and

understand the relationships of co-dependence between the elements that make up complex systems, such as human beings and social systems.

Acknowledgments: I am especially grateful to Maria Eunice Q. Gonzalez, Renata Silva Souza and José Artur Quilici Gonzalez for the constant dialogue on the issues and problems discussed here. I would also like to thank the members of the Academic Group for Cognitive Studies - UNESP and the Self-Organization Group - CLE - UNICAMP whose contributions were fundamental to the preparation of this text. I thank Ricardo Peraça Cavassane for revising the English version of the text. Finally, I would like to thank UNESP, CNPq and FAPESP for their financial support.

References

Ashby, W.R. (1962). Principles of the self-organizing system. In: Foerster, H.V.; Zopf Jr., G.W. (Eds). *Principles of Self-Organization:* Transactions of the University of Illinois Symposium. Pergamon Press: London, UK, p. 255-78. Available at: http://csis.pace.edu/~marchese/CS396x/Computing/Ashby.pdf.

Batty, M.; Torrens, P.M. (2001). Modelling complexity: The limits to prediction. In: Caruso, G.; Gerber, P.; Jones, K.; Klein, O.; Perchoux, C. *Proceedings of the 12 ème Colloque Européen de Géographie Théorique et Quantitative*. St-Valéry-en-Caux, France, p. 7-11. Available at https://journals.openedition.org/cybergeo/1035.

Bostron, N.; Ord, T. (2006). The Reversal Test: Eliminating Status Quo Bias in Applied Ethics. *Ethics*, 116, 656–79. Available at: https://www.nickbostrom.com/ethics/statusquo.pdf.

Brignell, V. (2010). The eugenics movement Britain wants to forget. *NewStateman*. Available at: https://www.newstatesman.com/society/2010/12/british-eugenics-disabled.

Chesterton, K.G. (1922). *Eugenics ant other evils.* London: Cassell and Company, 1922. Available at: https://ia800209.us.archive.org/21/items/cu31924013462555/cu31924013462555.pdf.

Darwin, C. (1874). *The descent of man*. 2nd ed. London: J. Murray, 1874. Available at: http://bibliotecadigital.puc-campinas.edu.br/services/e-books/Charles%20Darwin-1.pdf.

Debrun, M.A. (1996). A idéia de auto-organização. In: Debrun, M.A.; Gonzalez, M.E.Q.; Pessoa Junior, O. (Eds.). *Auto-organização:* Estudos Interdisciplinares. v. 18. Campinas: Coleção CLE, p. 1-23, 1996.

Galton, F.R S. (1907). *Inquiries into human faculty and its development.* London: J. M. Dent & Co., 1907. Available at http://galton.org/books/human-faculty/text/human-faculty.pdf.

Fukuyama, F. (2002). *Our Posthuman Future:* Consequences of the Biotechnology Revolution. New York: Farrar, Straus & Giroux, 2002.

Heyes, C.; Huber, L. (Eds.). (2000). *The evolution of cognition.* Cambridge, Massachusetts/London: The MIT press, 2000.

Holm, S. (1994). Genetic Engineering and the North-South Divide. In: Dyson, A.; Harris, J.J. (Eds.). *Ethics and Biotechnology*. New York: Routledge, 1994.

Humanity +. (2009). Transhumanist Technology. *Transhumanist Declaration*. Available at: https://humanityplus.org/philosophy/transhumanist-declaration/

Huxley, J. (1947). *Man in the modern world*. Great Britain, 1947. Available at https://ia802308.us.archive.org/2/items/ManInTheModernWorld/ManInTheModernWorld.pdf.

Huxley, J. (1957). *New bottles for new wine*. London: Chatto & Windus, 1957. Available at: file:///C:/Users/DFIL/Downloads/New-Bottles-For-New-Wine_text.pdf.

Joyce, R. (2006). *The evolution of morality*. Cambridge, Massachusetts/London: The MIT press, 2006.

Kass, L. (2002). *Life, Liberty, and the Defense of Dignity*: The Challenge for Bioethics. San Francisco: Encounter Books, 2002.

Kauffman, S.A. (1993). *The origins of order. Self-organization and selection in evolution.* New York and Oxford: Oxford University Press, 1993.

Kevles, D.J. (1986). *In the name of eugenics: Genetics and the uses of human heredity*. Berkley and Los Angeles: University of California Press, 1986.

Kropotkin, P.A. (1902). *Mutual aid:* A factor for evolution. London: McClure, Philips & Company, 1902. Available at: http://www.gutenberg.org/cache/epub/4341/pg4341-images.html.

Malthus, T.R. (1798). *A n Essay on the Principle of Population As It Affects the Future Improvement of Society, with Remarks on the Speculations of Mr. Goodwin, M. Condorcet and Other Writers.* London: J. Johnson in St Paul's Church-yard, 1798. Available at https://archive.org/details/essayonprincipl00malt/page/n8/mode/2up.

Mazumdar, P.M.H. (1992). *Eugenics, human genetics and human failings: The Eugenics Society, its sources and its critics in Britain.* London and New York: Routledge, 1992.

Mitchell, M.; Newman, M. (2001). *Complex systems theory and Evolution*. Santa Fe: Santa Fe Institute, 2001.

Nummenmaa, L.; Glerean, E.; Hari, R.; Hietanen, J.K. (2014). Bodily maps of emotions. *PNAS*, January 14, 2014, 111(2), p. 646-51. Available at: https://doi.org/10.1073/pnas.1321664111.

Smith, J.D. (2009). The study of animal metacognition. *Trends in Cognitive Sciences*, 2009, 13, 389–96.

Soloway, R.A. (1984). *Birth control and the Population Question in England, 1877-1930*. The University of North Carolina Press, 1984.

UNESCO. (1952). *The race question in modern science:* The race concept – result of an inquiry. Paris, 1952. Available at: https://unesdoc.unesco.org.

Waal, F. (2000). Primates: A Natural Heritage of Conflict Resolution. *Science*, 2000, 289(5479), 586-90.

Waal, F. (2010). *The age of empathy:* Nature`s lessons for a kinder society. London: Souvenir Press, 2010.

Wade, M. (2008). Evolutionary Genetics. In: Zalta, E.N. (Ed.) *The Stanford Encyclopedia of Philosophy*. 2008. Available at: https://plato.stanford.edu/archives/fall2008/entries/evolutionary-genetics/.

Wolf, L. (2014). Forced Sterilization. In: *Women and Global Human Rights*. 2014. Available at: http://faculty.webster.edu/woolflm/forcedsterilization.html