

ARTÍCULO

---

**Ethics and genetics. A quick view<sup>1</sup>**

JOSEP SANTALÓ \*

*The Master in Bioethics and Law at the University of Barcelona supports the Bioethics and Law Journal: [www.bioethicsandlaw.es/master](http://www.bioethicsandlaw.es/master)*

---

\* Josep Santaló. Unitat de Biologia Cel·lular. Facultat de Ciències. Universitat Autònoma de Barcelona.

<sup>1</sup> This article was published in: Revista de Bioética y Derecho UB, no. 21, 2011.

## Resumen

La Biotecnología, en su sentido más amplio (las tecnologías basadas en la biología), es una de las tecnologías más notables derivada de los conocimientos de mediados del S. XX hasta el S. XXI. En su desarrollo, la biotecnología ha ofrecido la posibilidad de mejorar nuestro conocimiento de las características más íntimas de un ser vivo, es decir, su *código genético* e incluso, una vez obtenido este conocimiento, ir más adelante y modificarlo. La disciplina que ha llevado a estas transformaciones es la genética y todas las tecnologías basadas en ella. Como mencioné, la capacidad de promover el desarrollo de estas tecnologías se ejerce primero a través del simple conocimiento (**información genética**) y el segundo a través del cambio de las características genéticas de los individuos (**manipulación genética**). Dependiendo de las especies involucradas en el proceso biotecnológico, nos referimos a esta manipulación como **ingeniería genética** (cuando se aplica a otras especies no humanas) o como **terapia génica** (si se aplica a la especie humana).

Todas estas tecnologías tienen cuestiones éticas que deben abordarse, preguntas que han cambiado profundamente el concepto del lugar que ocupa la humanidad en el universo, e incluso, el concepto mismo de humanidad.

**Palabras clave:** ética; genética.

## Abstract

Biotechnology, in its wider sense (technologies based on biology), is one of the most striking technologies derived from knowledge appearing in the middle XX and early XXI century. In its development Biotechnology has offered the possibility of improving our knowledge on the most intimate characteristics of a living being i.e. its *genetic code* and even, once having this knowledge, going a step forward and alter it. The discipline that has prompted these transformations is *genetics* and all the technologies based on it. As mentioned, the capacity to promote the development of these technologies is exerted first through the simple knowledge (**genetic information**) and second through changing the genetic characteristics of individuals (**genetic manipulation**). Depending on the species involved in the biotechnological process we refer to this manipulation as **genetic engineering** (species other than humans) or as **gene therapy** (human species).

All these technologies have ethical questions to be addressed, questions that have deeply changed the concept of the place humankind occupies in the universe and even the concept of humanity itself.

**Key words:** ethics; genetics.

## General ethical aspects

There are some general aspects to be considered when talking about the ethics related to Biotechnology; concerns that can be argued to almost all the biotechnological procedures we will discuss later. These ethical aspects are: availability and the caution principle (also referred to as the *slippery-slope principle*).

### Availability

In general, Biotechnology is a high technology field, so it is time consuming and expensive, making it available only to well developed countries or to economically powerful people. These economical implications produce a drift in the way Biotechnology evolves, often leaving some interesting research apart due to profitable criteria instead of general well-being ones. Such is the case of the research on malaria vaccine or the development of transgenic rice producing vitamin A precursors (golden rice). Therefore we have to be aware that although *distributive justice* applied to Biotechnology is generally accepted, it is not always exerted.

### Caution principle

Although caution principle could be applied to any new technology, it has been especially invoked in Biotechnology.

Caution principle states that no new technology should be used (or even developed) until enough guaranties that it is harmless are obtained. This principle, although sound, can impair scientific progress if applied to its extreme. Most technologies have dual aspects and misuse of them towards undue or perverse objectives should not impair their development. Emmanuel Kant (1784) already consecrated the necessity of scientific improvement in its essay "Answer to the Question: What is Enlightenment?" when he wrote "An epoch cannot avert or commit itself to put the following one in a situation that will be impossible to expand its skills (in particular those of maximum urgency), purify them of errors and, in general, further progress in the Enlightenment. That would be a crime against human nature, the original destination of which lies precisely in this progress ..." meaning that, since present knowledge and technologies are based on the knowledge developed by precedent generations of scientists while present science becomes the groundwork of future knowledge; banning some research can cause delays and undesired effects on future generations. For instance, transgenic technology or somatic cell nuclear transfer (cloning) in humans have evolved much more slowly due to this prevention.

Therefore it seems clear that, although not everything that can be done should actually be done, invoking the caution principle may impair the development of new technologies that might offer better live conditions to future human generations. Seeking a balance between advantages and risks (*proportionality principle*) seems to be the soundest approach to this apparent conflict.

## Genetic information

Referring to humans, Biotechnology offers the possibility of developing personalized medicine (pharmacogenomics, toxicogenomics) which provides genetic information of the individuals. The use of this information can be done by the same individual (*self genetic information*) or by others.

In general, the ethical aspects of using self genetic information are envisaged as less relevant because it is assumed that having this information can be regarded as a right to be exerted by persons. The main questions to determine are to which extend people have the right to achieve this self-knowledge, a knowledge that is expensive and difficult to be obtained (at least at present), and who should assume the cost of providing this information. Availability is thus the key point to be addressed in this topic.

Although knowledge (and especially self knowledge) is generally viewed as something positive it can also have negative aspects thus arising the *right of not knowing*. This situation appears when the person is at risk of suffering a genetic disease for which no cure is available. Under this situation, revealing the information without an appropriate consent should be considered as ethically unacceptable.

By contrast, it is generally accepted that the use of personal genetic information by third parties (other persons, companies or institutions) has important ethical and social implications. Ethical concerns in this field are mainly derived either from its *commercial use* (exchanging personal genetic data between companies) or from *discrimination* exerted due to this knowledge (for instance people losing their jobs because a genetic predisposition to some kind of cancers or paying extra fares to insurance companies for the same reason). All these preventions are pondered at Article 10 on Private life and right to information of the Oviedo's Convention (Council of Europe, Convention on Human Rights and Biomedicine, 1997).

Finally, some people fear that getting genetic information specific for some human populations may recover old concepts such as human race, thus acting as an intellectual support to new forms of racism.

## Genetic manipulation

### Genetic engineering

Genetic engineering refers to the modification of the genetic characteristics of species other than humans (either bacteria, plants or animals; generically referred to as *GMO -genetically modified organisms-* or transgenics) to adapt them to the interest of human beings. In fact, it can be considered as a sophisticated form of domestication having the advantage of being faster and more straightforward. However, concerns have appeared related to the use of this technology. Ethical concerns are mainly related to the general aspects already mentioned such as availability and, especially, the caution principle.

While a direct influence of transgenic technologies on the human health has been almost discarded, the caution principle has been mainly invoked because the *threat GMOs may represent to environment*. Although this is a long debate in which scientists and environmentalists argue that no direct proves of detrimental effects on nature of GMOs have been reported, the contrary (proves on the innocuousness of GMOs to environment), seems too still be true. Main worries come from reduction on biodiversity and substitution of natural organism by uncontrolled GMOs which, at the end, may threat other fragile ecosystems. Responsibility for leaving a safer world, free from environmental catastrophes to next generations is at the center of this debate.

Transgenics have been proposed to be used either as bioreactors, to generate products through biochemical pathways in organisms not normally producing them, or to act as a source for xenotransplants, by producing organs (*xenoorgans*) in animals susceptible to be transplanted to humans. While no especial concerns come up in the first aforementioned application, production of xenoorgans do arise ethical concerns. *Production of chimeras* (organism having cells from two or more different origins, especially from different species) pose ethical preventions, mainly when these species are very close. Worries appear when the possibility of generating hybrids between human and close related species, such as apes, may become true. The consideration of this chimeras and even their own self consideration, if they could have any kind of self consciousness are, without any doubt, one of the most scaring faces Biotechnology could offer.

Recently Biotechnology has moved one step further after the report of what has been called *synthetic biology*, which refers to the creation of a completely new organism (a bacteria) after designing its whole genetic code. Such an approach could be considered at present a sort of "global transgenic", since it has been conceived as a combination of different genes coming from different organisms. Claims against this possibility have arisen using arguments such as scientists *playing God* or going against the *natural order of things*. Although respectful, all these arguments seem not to have a solid scientific groundwork and should be maintained in the religious parcel for believers. The playing God concern can be considered as a variant of the caution principle since supporters of this argument maintain that, unlike God, we are not omnipotent and omniscient, thus unforeseen and uncontrollable effects may appear when developing such technologies. In fact though, the caution principle we have already discussed is the main argument that can be proposed besides those religious ones. With respect to "going against the natural order of things", namely going against natural evolution, this is an argument that can be asserted too against any medical intervention which converts it as obviously grotesque.

## Gene therapy

When genetic manipulation is exerted on human beings it is referred to as gene therapy since, in general but not exclusively, the main objective of this procedure is to look for the remediation of a disease. We will later discuss how gene modifications in humans can also be used to improve human individuals thus constituting a sort of active *eugenics*.

Gene therapy can be employed on cells (cell therapy, which includes regenerative medicine) or on embryos. This later use derives from the availability of human embryos offered by reproductive medicine, a biotechnological process with a wide variety of ethical implications to be discussed.

## Cell therapy – Regenerative medicine

Cell therapy is based on the use, manipulation and genetic modification of cells. Cell therapy doesn't have ethical implications except when it is performed on a special type of cells known as *stem cells*. These cells are at an undifferentiated state (they are *pluripotent*) so they can be derived into any kind of cells of an organism to regenerate damaged tissues and organs from individuals (*regenerative medicine*). Stem cells can be obtained from adult cells either directly (*adult stem cells*) or by inducing their pluripotentiality (*induced Pluripotent Stem Cells -iPS-*). The use of both type of cells does not present any ethical concern but they have some biological characteristics that might make them unsuitable for some regenerative processes. By contrast, stem cells derived from human spare embryos (*embryonic stem cells -ESC-*) do have the capacity to be derived to any kind of cells and seem to be suitable for regenerative medicine; nevertheless they pose serious ethical concerns since their production implies embryo destruction. Worries about their use arise from the consideration a human embryo deserves, however we will discuss this topic later in the Reproductive medicine section.

One of the most serious drawbacks that regenerative medicine must face is immunological rejection. To solve this problem self transplant is proposed which implies the use of cells derived from the same adult organism (iPS) or the use of cloning technologies to derive genetically identical ESC, what has been called *therapeutic cloning*. Cloning technology, initially developed for transgenic animal production, has been widely criticized because it has been considered, according to the slippery-slope principle, an open gate to reproductive cloning (which will be later discussed at the Reproductive medicine section).

## Gene therapy in embryos

Modification of the genetic characteristics of a whole human organism set forth a deep ethical concern: assuming that genetic characteristics are what ultimately defines an individual, is it ethically acceptable to modify them thus producing a "new individual"? Should we consider such procedure a sort of assassination of the old, original individual? Moreover, to which extend should we apply this technology?; should we use it merely to modify abnormal characteristics (merely *healing*) or should we go one step forward and modify some behavioral traits (*biological enhancement*)? In so far some traits considered valuable to offer greater all-round capacities to better living (intelligence, memory, self discipline, patience, empathy, optimism, etc...) have some genetic basis, genetic manipulation could alter them thus benefiting individuals. Traditionally all these characteristics are modified by environmental enhancement (education and cultural refinement); biological enhancement could be considered another way to address the same objective: increasing people's chances of conducting a better life. According to the *beneficence principle* (all action must be in benefit of individuals) we

could consider we have a moral obligation to do such. As stated by J. Savulescu (2007) “Biological manipulation to increase opportunities is ethical. If we have an obligation to treat and prevent disease, we have an obligation to try to manipulate these characteristics to give an individual the best opportunity of the best life”. In fact biological enhancement, while increasing people’s well-being, could be considered equivalent to treating diseases since health is not only the absence of pain, but also achieving the maximum well-being.

However, against biological enhancement it has been argued that, as already mentioned, it could be considered as altering the identity since it would be altering the genetic characteristics of individuals. It could be reasoned this being true only if significant alterations of mental capacity have been performed, but what does “significant alterations” mean? Again, the extend of changes occupies the center of the debate.

Moreover, M. Sandel (2004) proposed that designing children leads to master the mystery of birth, alters the paterno-filial relationships and deprive parents of humility by banishing the appreciation of life as a gift, leaving them with nothing to affirm or behold outside their own will.

For all these reasons Oviedo’s Convention, in its Article 13 reads: “An intervention seeking to modify the human genome may only be undertaken for preventive, diagnostic or therapeutic purposes and only if its aim is not to introduce any modification in the genome of any descendants” completely banning gene therapy in embryos.

The alternative to embryonic genetic manipulation is embryo selection using *preimplantation genetic diagnosis*. This is a procedure set for identifying genetically abnormal embryos before implantation, aiming at transferring only those being normal, while discarding the rest. Since at present technology cannot offer a complete screening of the whole genome of the embryo, it was initially developed to detect abnormal embryos from couples with high risk of presenting a determined genetic disease. However it has been evolving since it was first developed in 1992 and new applications have been proposed: detection of predisposition for diseases (some forms of breast and colon cancers), selecting embryos immunologically compatible with severely ill elder siblings to generate individuals acting as donors of cord blood stem cells (called *HLA matching*), or even selecting embryos of the desired sex without any medical indication (what is commonly referred to as *social sexing*).

Complaints against preimplantation genetic diagnosis have been proposed in the sense that it can be regarded as a sort of *eugenics*. Eugenics is defined as “a science that deals with the improvement (as by control of human mating) of hereditary qualities of a race or breed” (Merriam-Webster dictionary); however in this case no improvement of a human group is pursued but avoiding the birth of a children affected by a severe genetic disease.

*Instrumentalization* of the embryos and therefore the children derived from them is another criticism preimplantation genetic diagnosis must face, especially addressed to HLA matching or social sex procedures. *Kantian categorical imperative* (Groundwork of the Metaphysic of Morals, 1785) states that any rational individual can never be used merely as a mean to our ends, but always as an end in him or herself. This argument can be considered as absolutely true for children but may be not for embryos, since preimplantation embryos are often not regarded as persons having a moral status (see Reproductive medicine section). Referring to the children’s instrumentalization it is in fact a quite common situation (for instance, children in part being conceived to heir a fortune, or to continue a constitutional monarchy or simply to solve relationship problems

between the couple's members). Therefore, wouldn't saving an already existing life (HLA matching) be a "good reason" to partially instrumentalize a child?

Fears on demographic unbalancing of the undesired sex, an argument often used against sex selection, seems to be excessive when applied to preimplantation diagnosis since this is not, and it probably never will be, a widespread technology. Moreover, much more dramatic systems to exert sex selection, such as selective abortion or even assassination, have been and are still being used.

The deepest complains appear again when trying to decide to which extend these procedures could be used; will we accept HLA matching for embryo's siblings? But, what about for cousins or for non family persons? Will we accept social sexing only to balance the genres in a family? Or only if preimplantation diagnosis has been performed for medical reasons and during this process the embryo's sex is collaterally obtained? Will it be acceptable if embryos of the undesired sex are donated for adoption to couples with reproductive problems? Guidelines and law are extremely variable in this matter, depending on cultural and religious tradition of different countries and societies.

## Reproductive medicine

Reproductive medicine makes human embryos available for the first time in history thus leading to a deep debate on the moral and legal considerations of the human embryo. There are two main positions that can be adopted on this debate: human embryos should be considered as persons from the moment of conception onwards or they should be considered as potentially persons but not actual persons in such early stages of development.

The first position is supported by non-reductionist (religious) conceptions. According to the Catholic Declaration of the Pontifical Academy for Life "On the basis of a complete biological analysis, the living human embryo is - from the moment of the union of the gametes - a human subject with a well defined identity, which from that point begins its own coordinated, continuous and gradual development, such that at no later stage can it be considered as a simple mass of cells". However, hydatidiform moles (a kind of abnormal pregnancy that can develop into some embryonic cancers), naturally occurring twinning or Siamese phenomena threatens this idea, since none, one, two or even something between one and two individuals can be derived from the same embryo. Under the first point of view a human embryo has a full *moral status* since it is considered a person; under the second one it does not have a moral status, although it can possess a *moral value* meaning that there are moral reasons to treat it in certain ways and not in others. According to the report brought about by NIH Human Embryo Research Panel, while the preimplantation human embryo "does not have the same moral status as infants and children ... it deserves special interest and serious moral consideration as a developing form of human life". This special interest and respect (something similar to the respect offered to human remains and corpses) is expressed by placing restrictions on their use according to only morally significant purposes. This later position is the one mainly adopted by legislations on human embryo research in most developed countries.



Another field of debate on the consideration human embryos deserve is the *Kantian respect*, directly derived from the categorical imperative already mentioned. Kantian respect encourages us to treat others (including embryos, it could be argued) as ends in themselves. To treat others as ends in themselves we must take their ends (their interests, projects and goals) seriously and not just our own. It has been argued that since embryos do not have interests or ends they cannot be considered as ends in themselves, therefore Kantian respect cannot be applied to preimplantation embryos. But which argument supports the idea that embryos do not have interests? This idea derives from the fact that embryos in such early stages do not have sentience. In this sense B. Steinbock (2007) proposes “Without experiences of any kind,” (preimplantation embryos do not have any nervous cell) “embryos cannot have wants. Without wants they cannot have a stake in anything, including their health or continued existence...My claim is...they do not have an interest in being healthy or in continuing to exist”. She adds “Sentience is a condition, not of having interests, since temporarily non-sentience beings can continue to have interests in the dispositional sense, but of acquiring interests”. To have interest in the dispositional sense means to have inherent interest in one’s own welfare although not being aware of it.

The second ethical hot spot of reproductive medicine is *reproductive cloning*. In fact, this is a misleading term since clones cannot be considered as the offspring of the original individuals but their asynchronous twins, therefore they better should be envisaged as siblings. This procedure is based on *somatic cell nuclear transfer* technology developed to produce transgenic animals which allowed the birth of the first mammalian clone, Dolly the sheep, on 1996. Although it has not been yet performed in humans or apes, and even some authors believe that it will never be possible to carry it out, it has arisen long and heated debates.

Human cloning has been proposed to be acceptable according to *reproductive freedom* but has been considered as unethical because of many other reasons; being the most widely extended that is contrary to *human dignity*. UNESCO’s Universal Declaration on the Human Genome and Human Rights in its Article 11 reads: “Practices which are contrary to human dignity, such as reproductive cloning of human beings, shall not be permitted” and the Oviedo’s Convention on the Prohibition of Cloning Human Beings in its Preamble reads: “Considering ... that the instrumentalisation of human beings through the deliberate creation of genetically identical human beings is contrary to human dignity and thus constitutes a misuse of biology and medicine...”. However, human dignity is a very blur concept that is not well defined in both declarations, not clarifying whose dignity is threatened by cloning: embryo’s dignity, individuals’ to be cloned, individuals’ that perform the cloning process, mankind dignity? All these uncertainties make both declarations susceptible of severe counterargumentations (Birnbacher, 2005). Another argument against reproductive cloning is that it will decrease genetic diversity of humankind; this is a true argument but it would have a noticeable effect only if it were widely used, which probably will never be the case. It also has been argued that it can deprive clones from an open future, which is obviously a weak argument since genetics cannot predetermine a whole human life. Finally the only sound and well founded argumentation against reproductive cloning is that it yields an extremely negative balance between benefits and risks (*negative proportionality principle*). At present, cloning technology poses a serious threat to clone’s health and well-being since clones suffer from high spontaneous abortion rates, increased perinatal death rates and fetal malformations; moreover, there are no reproductive problems that can be solved exclusively by cloning, thus making it useless. According to this, even developing

human cloning technologies would imply a large, unacceptable amount of children with severe health problems just to fulfill the odd desire of some people.

Reproductive medicine is a fast evolving field that is constantly raising new ethical concerns ready for debate. Recently it has been reported that, in animals, ESC can be derived into cells resembling gametes which probably soon will have reproductive capacities. This possibility raises two new ethical worries. The first one has already been referred as *ultimate incest* because it could offer the possibility of self sexual reproduction (which is clearly different from cloning) since both male and female gametes might be derived from the same cells. The second one appears if ESC are used to produce gametes to solve the shortening of gamete donors in most countries: by doing so we would allow individuals that have never existed to reproduce; will we consider it as ethically acceptable?

We have done a very quick view over some ethical aspects biotechnology has confronted us, but it surely will continue to rise new ones as new technologies appear; thinking and arguing on them based on true information without apriorisms is our duty as democratic and well developed societies.

## Acknowledgements

Author wish to thank Dr. Elena Ibañez for helpful reading of the manuscript.

This document has been produced for Xplore Health Project with funding from European Commission Seventh Framework Programme under Grant Agreement nº 241873.

## References

- ◆ Birnbacher D. 2005. Human cloning and human dignity. *Reproductive Biomedicine On line*: 10 (suppl. 1), 50-55.
- ◆ Kant E. 1784. Beantwortung der Frage: Was ist Aufklärung?. *Berlinische Monatsschrift*. (December issue), 516.
- ◆ Kant E. 1785. *Grundlegung zur Metaphysik der Sitten*. *Groundwork for the metaphysics of morals*. 2002. tr. Arnulf Zweig, Thomas E. H., Jr. and Zweig A. (eds.). Oxford University Press. Oxford.
- ◆ Sandel M. 2004. The Case Against Perfection. *Atlantic Monthly* (April issue), 51-62.
- ◆ Savulescu J. 2007. Genetic interventions and the Ethics of Enhancement of Human Beings. In Steinbock B. (ed.). *The Oxford Handbook of Bioethics*. Oxford University Press. Oxford. pp 516-533.
- ◆ Steinbock B. 2007. Moral status, moral value, and human embryos: Implications for stem cell research. In Steinbock B. (ed.). *The Oxford Handbook of Bioethics*. Oxford University Press. Oxford. pp. 416-440.