

Ethics of research in times of synthetic biology

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Creating Life?

- Whereas biology before the invention of recombinant DNA techniques had been an analytic and descriptive science, it became afterwards capable of “constructing new sets of DNA” (Sybalski and Skalka, 1978).
- The shift from analysis to synthesis as an expression of scientific progress highlights a shift toward instrumental knowledge.
- Knowledge in natural sciences became a tool for manipulating objects.
- The shift from mere observational analysis to the ability to build, initiate and steer DNA based processes.
- Synthetic biology is characterized by two features:

Beyond genetic engineering

- Genetic engineering is restricted to transplanting short strains of DNA into a host organism, thereby adding or changing single features of an otherwise stable organism.
- The ability to synthesize genomes opens up the possibility to alter the whole DNA related behavior of prokaryotic single cell organisms at once (**Craig Venter**).
- Numeric expansion from genetic engineering 5k base pairs to synthetic biology strings of 600k base pairs. This increase in DNA synthesis makes a difference regarding the appeal to “creation,” and constitutes a shift of paradigm, from manipulation to creation.

Synthetic biology top down / bottom up strategies from editing to writing

- It uses parts and pieces of already existing organisms.
- It presupposes the existence of life.
- Bottom up approaches aim at building artificial cells completely from single molecules, but they are further from realization and emerge under certain conditions.
- The perspective of creation in today's synthetic biology resumes the early expectations concerning a shift from analysis to synthesis.

Hans Jonas' ethics

- In biogenetic technology he wrote:
“The work of the hands of homo faber (...) literally gains life of its own and a certain degree of autonomy.”
- So, in synthetic biology, what is the ethical significance of conceiving oneself as a creator of life rather than as a manipulator of existing organisms ?

Observing life is not enough?

- Our ethical assumptions are relevant because they establish humans as persons who are able to act responsibly.
- Freedom and coexistence are the framework of ethical understanding.
- In contrast, *cause and effect* accounts for specific forms of behavior since they are considered as pure matter of fact, supposed to deliver deterministic understandings.

Novel forms of life?

- Generating reliable rules and methods for risk assessment will be the most pressing endeavors in order to promote a responsible use of synthetic organisms.
- As we advocate in the Arrige association (<http://arrige.org/>):
 - We must also contextualize synthetic biology
 - Cure illness and secure ecologically sustainable science.

Metaphors in the science of gene editing

- Computer technologies and molecular biology are transforming human lives and what it means to be human.
- Metaphors are displacing meaning from common sense to describe these new technologies and mediate public understanding of innovation. They open gene editing to bioethical scrutiny to increase public accountability or compliance. This is not neutral biopolitically.
- It opens up an “acclimatizing garden” of new forms of representation.
- Asymmetry of knowledge will fade with time.

Anthropology and synthetic biology

- **Paul Rabinow** calls *bio-sociality* the geneticization of social life and institutions (1996, 2000, 2015). He rightly underscores the co-constitution of nature and culture, as does **Escola** or **Marshall Sahlins**.
- Those biological anthropologists study the interaction between bioinformatics and cultural historical context of producing norms in synthetic biology, whose field is to extend or modify the behavior of organisms and engineer them to perform new tasks (**Andrianantondro** et al 2006).
- Appeal to nature and the natural in debates about synthetic biology and emergent behavior from natural biology raise concern in the public.

Is it different from other techniques, in kind, or in degree?

- Synthetic biology involves:
 - building living organisms from raw material,
 - building organisms from parts already found in living organisms.
- The first point uses “unnatural molecules” to reproduce emergent behaviors from natural biology to create artificial life.
- The second seeks “interchangeable parts” from natural biology to be assembled in systems that function unnaturally (Benner and Sismour 2005).

Different in kind?

- According to some critics, it is different from other techniques in kind because it involves novel efforts at synthesizing living materials “from the ground up” for specific human aims.
- It moves beyond merely revising or recombining given items and involves a reorientation toward living organisms.
- It is thus an engineering that blurs conceptual and normative lines between organism and artifact, between organic and synthetic, between living and nonliving.

Moral issues raised

- The metaphor of “playing God” should be problematized.
- It refers to human responsibility of being guardian of nature and its transgressions. It is used by religious people as well as by essentialist ecologists.
- Concepts of nature and the natural are some of the most widely invoked terms in ethical and policy discussions of biotechnology’s legitimate (or not) promises, or perils of new biology.

Appeals to Nature

- Appeals to nature implicitly rely on notions drawn from substantive frames of reference, issues raised by philosophers in terms of ontology, epistemology, ethics or anthropology.
 - Nature as evolutionary
 - Nature as emergent
 - Nature as culture
 - Nature as “sacred”
- Mixing facts and beliefs rather than arguments in ethical discussions.

The case of environmental ethics

- To appreciate Nature as that which precedes, or hosts humans is to be reminded both of our Stance as valuers and of nonhuman aspects of the world.
- This sense of nature is much present in the recent literature of environmental ethics (see Rolston, 1988).
- Cultural readings of nature exhibit deep divisions on quite fundamental matters such as :
 - The permeability of “species as natural kinds” with consequences about the legitimacy of genetic alteration.

It is vital to develop a consensual agenda

- It has implications about the appropriate scope of human responsibility vis a vis the “natural world”.
- Be it ordered, broken, suffused with telos, etc.
- Central moral questions include the relation between humankind and the larger world, including animals, plants, and environmental niches.
- Nature in science and medicine focused a greater attention on how particular accounts of nature reflect diverse historical understandings and perceive nature as a cultural construct.

Language of co-creation

- It suggests human engagement with nature, although the promise of responsibility is either cultural or issued from a voluntary choice.
- The playing god metaphor encounters secular critiques of non acceptance of bodily limits and a move in research that goes beyond therapy.
- Failure to accept the gifted character of Nature (Sandel 2004).

Public policy choices of semantics

- The appeal to the natural captures a range of concerns that function less as dispositive judgments than as the intuitive expressions of broader worldviews which have a cultural legitimacy in a pluralistic democracy.
- If some critics target synthetic biology as different in kind (**Boldt and Muller**, 2008), the distinction remains murky.
- So far, the organisms of synthetic biology *add to* rather than *alter* neo-Darwinian nature, so that the appeal to nature may be less applicable to synthetic biology than to other biotechnologies.

Human nature

- Human nature and culture are themselves a natural expression of human agency, the scientific character of human culture reshapes human biology.
- Literacy for example has measurable effects on brain development so that the nature vs culture divide is not so clear.
- Human relation to nature reflects a range of values. Because of our very limited knowledge, our alterations of the natural world should not be irreversible.

Overcoming dualities

- “We are currently living through an era in which the traditional dualities are failing.”
- Our grasp of what it means to speak of nature is weakening.
- Our forms of life are embedded in incompatible language games, would say **Wittgenstein**.

Biopolitics of genetics stories and women studies

- **Hilary Rose** analyzed the genetic work on the population of Iceland as an act of national commercialization and commodification of genetic data, questioning the confidentiality of collected information.
- **Donna Haraway** (a biologist) deconstructed the mixture of popular and scientific narratives on genetics subjectivity.
- This discourse is effective on eugenic populism, reappearing today on race and human variation, kinship and identity, disguised in technical knowledge... But building narratives is a craft.

The fourth industrial revolution

- We are confronted to a conflict of narratives with the metaphor of genome editing, in the context of a merge of genetic engineering with big data.
- “Can we edit the genome” of embryos ? This pertains to a culture of the soul replaced by algorithms.
- In Scientific American, **Jennifer Doudna** declared :
“I am not categorically against human germline editing. But I think there should be a reason to do it that would justify the risks.”
- So why should we, as a society or a species, assume those uncertain risks? Does it make sense? Should geneticists alone answer these questions, as Doudna did in her book *A Crack in creation?*

Tracing the line between anthropology and sensational science

- The rapid development of medical technologies cannot be adequately understood without attention to human personhood.
- We are not only bodily creatures sharing a genome but also plural social and cultural beings.
- Anthropology is bringing an awry gaze at the age of genetics engineering.
- Questioning the commodification of bodies in terms of social justice and intellectual property on human biological material.

Genetics, commodification and social justice

- The commercialization of biotechnology by transnational pharmaceutical companies relies on genetic engineering.
- The war on intellectual property reveals the anthropological dimension of the quest for power / knowledge involved in their biosocial quest.
- Ideology is not value free and overcomes the responsibility of science for some, while not assuming it totally for others.
- Epigenetic modification beyond the “designer baby” is at stake and worries most social scientists and philosophers, since scientists are only beginning to understand it, while already altering epigenetic mechanisms modulated by DNA expression.
- Scientific discourse and political life are taken over by market rhetoric and “fake news”.

Biotech market and geopolitics

- EU and UN documents call the human genome a “common heritage” and not a property open to commercial exploitation, but bio-patenting laws reflect the priorities of industrialized societies that exclude the poor, since the TRIPS agreement imposes an alien set of concepts of property (CIDSE, 2000).
- Some recommend to exclude all life forms from patenting... to preserve the common good as a social and economic reality. However, this notion is not prominent in United States ethos of “America first”, and on consumer choice.
- Private industry investments exceed by far the funding provided by governments (see “*Trading the genome, investigating the commodification of bioinformation*”, by B.Parry).

Biotech market and geopolitics (2)

- This situation allows, through the patent mechanism, to sell an invention or innovation.
- It places more control over the development of biotechnology in the hands of countries that can afford investments in scientific research through corporate sponsors. And creates geopolitical issues.
- The emergence of an international civil society is questioning this rhetoric, as well as organizations like **Unesco** promoting solidarity towards groups vulnerable to genetic diseases (Art 19), sharing of benefits, or protection of future generations...

Contextualizing our reflection in societal terms

- Epigenetic science is too young to determine social choices. We are not ants (see <https://m.phys.org/news/2017-08-gene-editing-induced-ant-social.html>).
- Who must exercise democratic safeguards on genome heritage or modification, alteration, or “editing”? They influence public trust, or generate fear, that is biopolitically responsible for the mistrust of democracies nowadays.
- Words matter and the phenomenology of their evolution is following some sociotechnical patterns that we must explore before we can regulate in terms of ethics.
- What has sociologically and technically changed, since the human genome project regulations, is a serious question.

Public trust and inclusive narratives

- Are our Western societies equipped to make the moral decisions, and subsequent public policies, required to democratize knowledge and gain the public's confidence?
- *“Every answer presupposes some moral theory and social philosophy, and there is no moral system that we can accept as uniquely correct.” (Nagel)*
- However, there is a method for determining overlapping consensus towards a responsible public policy aiming at genetic justice, based on reciprocity and mutuality.

Reciprocity and mutuality in the information age

- Reciprocity underlines the inequality between knowledge held by ordinary people and by practitioners of medical genetics.
- Justice requires that such knowledge be redistributed to the less well informed.
- Redistribution ensures that knowledge is transferred from the genetic engineer to the general practitioner. As this is already a problem, how can we genuinely foster “civic responsibility” and ensure a kind of ecological genome editing involving all interested parties?

By a readjustment of our social norms.

Can we “edit” future generations against wrongful life?

- History reminds us that we are responsible for the known, but more importantly for the uncertain.
- Future generations could coherently claim that governments acted irresponsibly in failing to regulate genome editing advances and their social consequences by lack of precaution.

Duty to know and recognition of our ignorance

- Recognition of our ignorance is the dual partner of the duty to know, at the core of the scientific adventure.
- It must govern the evermore necessary policing of our outsized might brought up by information technology.
- It compels us to readdress the metaphor of “genome editing” and its utopian, thus often deceiving, power.

How opposing Nature culture is inadequate anthropologically

- The genome as a fixed heritage is a myth, when we know that it undergoes continual alterations as a consequence of natural mutations.
- Does this legitimate man-made genome alteration? On what grounds? (see [Paul Rabinow](#)).

Interdependence among humans

- Biopolitical Ethics is about the responsibility of addressing the abuse of power on human bodies.
- Interdependence is the complement to autonomy and requires to rethink liberalism in a neo-capitalist context.
- It is a bioethical and sociobiological question that should be addressed concurrently by all disciplines to construct a sharable narrative.

New societal issues

- How will it affect reproduction and enhancement?
- Can we argue with liberal eugenists that it is a duty to enhance evolution?
- How will this statement affect the ideal of the good for humans, enhanced humans, posthumans?
- How we can separate curing and enhancing needs a transdisciplinary discussion and public participation.

Thank you for your attention and your questions

Further reading for discussion:

“Fostering responsible research with genome editing technologies: a European perspective”

<https://www.ncbi.nlm.nih.gov/pubmed/28730514>