



institut  
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de France



HAV919V

Integrated Physiopathology/Pathophysiologie intégrée

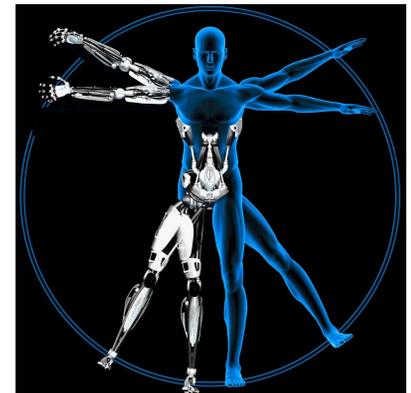
# Augmented human Science fiction became/becomes/will become reality?

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October 2022

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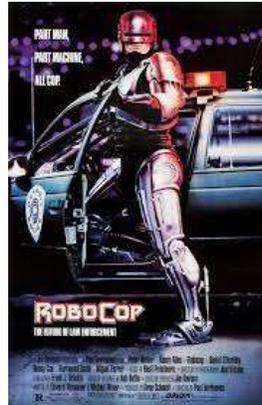
1984

Endoskeleton



1985

Exoskeleton



1987



2022?

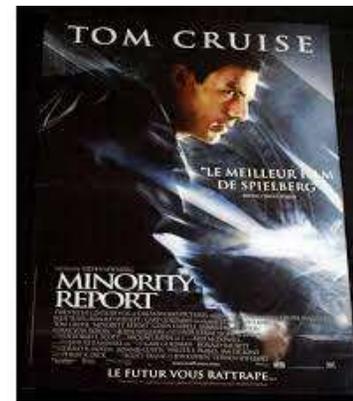
Cybernetically-enhanced cop



1999



2021



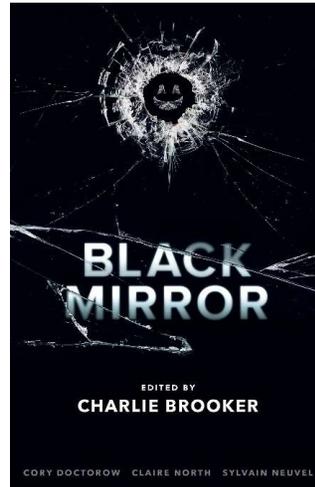
2002



2009



2022,  
December



Started in 2011

Statement : facts presented within this presentation do not necessarily reflect my opinions and beliefs.

**Augmented human:** development of technologies that repair/increase human sensory reception, physical ability or even cognitive capacity.  
Not transmittable to the next generation.

**Transhumanism,** social and philosophical movement devoted to promoting the research and development of robust human-enhancement technologies.  
Transmittable or not to the next generation.

## **Transhumanism : California : 1960-1970**

Unlimited improvement of the physical and mental faculties of the human being by all possible means:

- Chemical
- Genetic
- Mechanical (external tools, increase our abilities)
- Digital, notably thanks to "artificial intelligence".
- NBIC technologies (Nanotechnologies, Biotechnologies, Information sciences and Cognitive sciences)

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**Posthuman transhumanism:** a transhuman ideology and movement which seeks to develop and make available technologies that eliminate aging, enable immortality and greatly enhance human intellectual, physical, and psychological capacities, in order to achieve a "posthuman future".

Sapiens 2.0: new species based on an evolution of the genetic code

Human augmentation : taboo to many but ...we have been trying to repair/augment ourselves for centuries.

**Physical enhancements:** functional (prosthetics & powered exoskeletons), Medical (implants (e.g. pacemaker) & organ replacements ( e.g. bionic lenses)  
Hearing aids (repair but may also enhance)



Oscar Pistorius, in 2007 was faster than persons without disabilities at the Golden League, Roma

Aimee Mullins



# Exoskeleton



<https://youtu.be/RWnXOh4r6Dw>

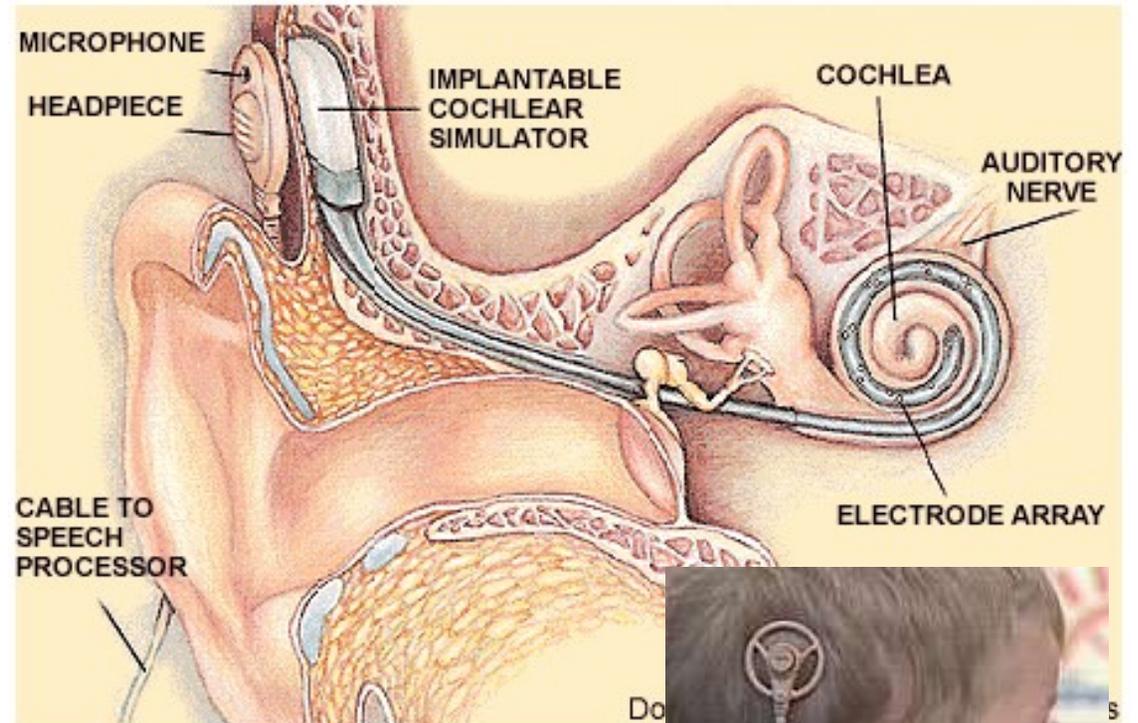
# Exoskeleton



[https://www.youtube.com/watch?v=ypSyff-\\_Bfw](https://www.youtube.com/watch?v=ypSyff-_Bfw)

## Cochlear implant: 1978

- microphone
- microprocessor (encodes sounds)
- Electrodes implanted in the cochleae



Earphone : transfers sound by bone vibration directly to the cochlea

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Hearing aids (repair but may also enhance)

Glasses (repair but may also enhance)

## Bionic Eyes With Thermal Infrared Vision In Development



<https://youtu.be/h7tYd7hHHUU>

Military ....

<https://www.youtube.com/watch?v=mc2fOI9vLzo>



**Neil Harbisson wears an antenna that allows him to "hear" color through vibrations in his skull.**



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Vaccine (protect through enhancement)

Cosmetics, plastic surgery & orthodontics

Drug-induced (doping & performance-enhancing drugs)

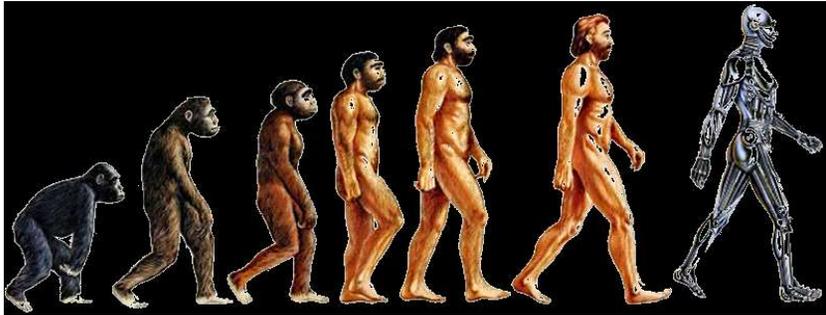
Human augmentation : taboo to many but ...we have been trying to repair/augment ourselves for centuries.

**Mental enhancements:** Nootropic substances or cognitive enhancers (caffeine, nicotine, amphetamine, medication used in narcolepsy, “smart drugs” .....) )

Computers, mobile phones, and Internet can also be used to enhance cognitive efficiency.

**Reproductive enhancements:** (embryo selection by preimplantation genetic diagnosis, *in vitro*-generated gametes).

# Transhumanism : enhanced human condition



*Homo sapiens to "Homo Novus"*

## WHAT FOR?

- Increase healthy lifespan (abolish death)
- Increases sensory and physical capabilities
- Increase intelligence
- Eliminate diseases
- Super human (war)
- Increase social difference (richer, fewer, power)

## HOW?

- Genetic
- Artificial intelligence
- Nanotechnology
- Sensors

## BUT ALSO

- Adapt human to new living condition (climate change, space...)
- Increase equality (correct defect, prevent diseases)

Denis Duboule, EPFL, Laboratory of Developmental Genomics  
Séminaire Académie Royale de Belgique, Collège France; Mai 2020.  
<https://www.youtube.com/watch?v=kgzfJvkXXUs>

Kevin Warwick, Institute for Cybernetics, University of Reading, UK

First implant 1998 : RFID, domotics (open door, switch on lights,...)



Then electrodes implanted in his harm nerve, directly connected to a computer

Ultrasonic signals given to his nervous system (electrodes).

Pulses of currents as f (distance of the object)

Experienced an extra sense.



Infra red, magnetic field

# Transhumanism



Ray Kurzweil, engineer specialist in artificial intelligence and digital brain and machine learning. Predictions : “Singularity is near” (event with unpredictable consequences). 2045. Computer intelligence is bigger than human.

Hired by Google in 2013

“To work on new projects involving machine learning and language processing”



**GAFAM:** [Google \(Alphabet\)](#), [Apple](#), [Facebook \(Meta\)](#), [Amazon](#) et [Microsoft](#)  
**BATX ; Baidu, Alibaba, Tencent et Xiaomi**

Body enhancement: bionic human, immortal men (Google, Calico, live longer and healthier, “cure death” 2014.  
Fight aging.

<https://www.calicolabs.com/> "California Life Company."

Intellectual Neuroaugmentation, increase in intellectual capacities with neuroelectronic, biologic

Mark Zuckerberg: Meta (Facebook), Metaverse 1992 science fiction novel [Snow Crash](#), immersive experience.  
immersive virtual world that is facilitated by the use of virtual reality and augmented reality headsets.



Elon Musk's brain chip company Neuralink . <https://neuralink.com/applications/>

**A Direct Link Between the Brain & Everyday Technology.** We believe this technology has the potential to treat a wide range of neurological disorders, to restore sensory and motor function, and eventually to expand how we interact with each other and experience the world around us.



Not science fiction but business model

Google and NASA are throwing their weight behind a new school for futurists that will prepare scientists for an era when machines become smarter than people.



**Singularity Education Group** (using the public names **Singularity Group**, **Singularity University** or **SingularityU**) is an American company that offers executive educational programs, a [business incubator](#), and business consultancy services.

## Artificial intelligence

**Narrow AI (weak)** : 1 specific task

- 1997 chess GARY Kasparov
- Alpha GO October 2015, in a match against [Fan Hui](#), the original AlphaGo became the first [computer Go](#) program to beat a human [professional Go player](#).
- Watson IBM Jeopardy: 2011

Machine learning, face recognition, Waze, Airbnb (big data management)

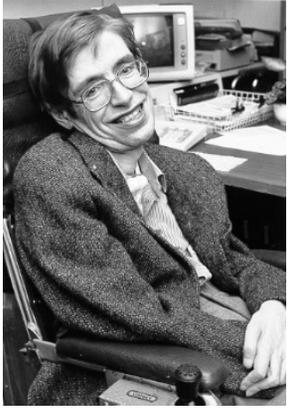
Diagnosis based on images of melanoma / carcinoma 92% vs 85%

Specific tasks can be replaced

Human genome ( now very fast cell specific sequencing, breast cancer, follow up mutations)

**Artificial General Intelligence (strong)** : human cognitive function

Able to find a solution when facing an unknown task.



Stephen Hawking, astrophysicist : "humans limited by their slow biological evolution will not be able to compete with the machine."

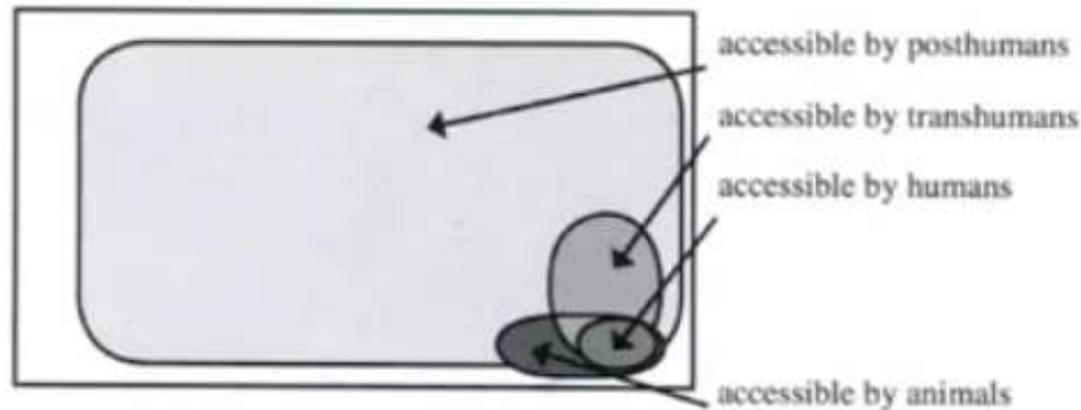
Zoltan Istvan, a former National Geographic journalist, he aims for immortality, nothing more and nothing less!

In the meantime, he founded the "Transhumanist Party" and was a candidate in the 2016 American presidential election, but could not prevent the election of Donald Trump.

Aubrey de Grey, a former computer scientist, who, thanks to the SENS (Strategies for Engineered Negligible Senescence) foundation, is mainly interested in research on aging.

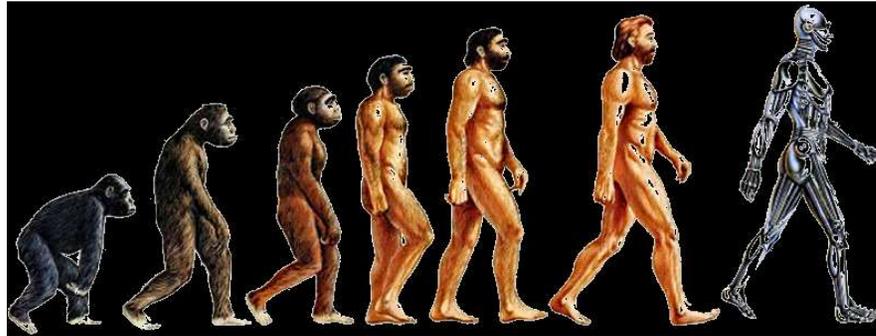
## *Homo sapiens to “Homo Novus”*

The Space of Possible Modes of Being



**Figure 1.** We ain't seen nothin' yet (not drawn to scale). The term “transhuman” denotes transitional beings, or moderately enhanced humans, whose capacities would be somewhere between those of unaugmented humans and full-blown posthumans. (A transhumanist, by contrast, is simply somebody who accepts transhumanism.)

## Transhumanism : enhanced human condition



Augmented human : equipped at birth

with camera sensors, computer .....

Not transmittable to the next generation

Modified human : genetic (human reproduction)

Embryo

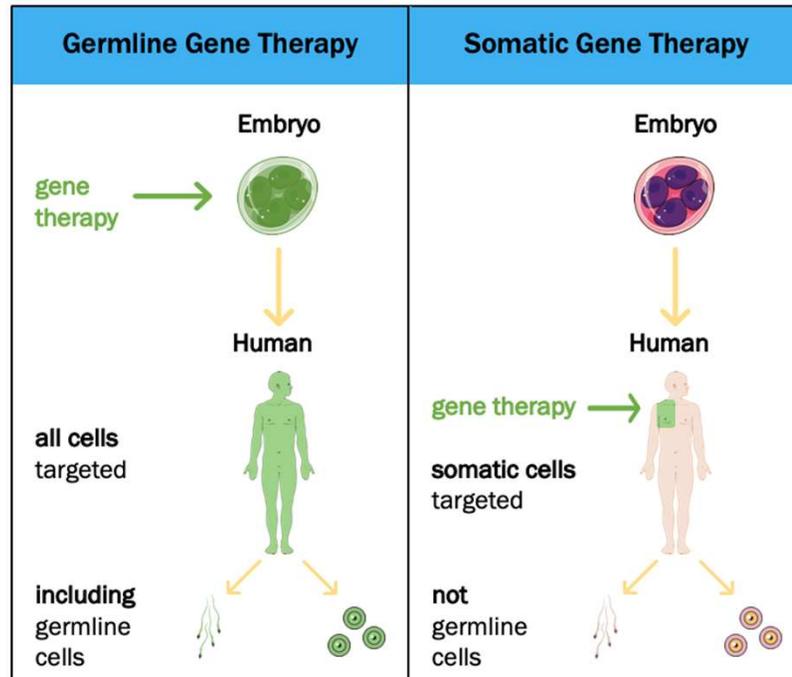
From stem cells, germ cells, *in vitro* fecundation

Transmittable to the next generation



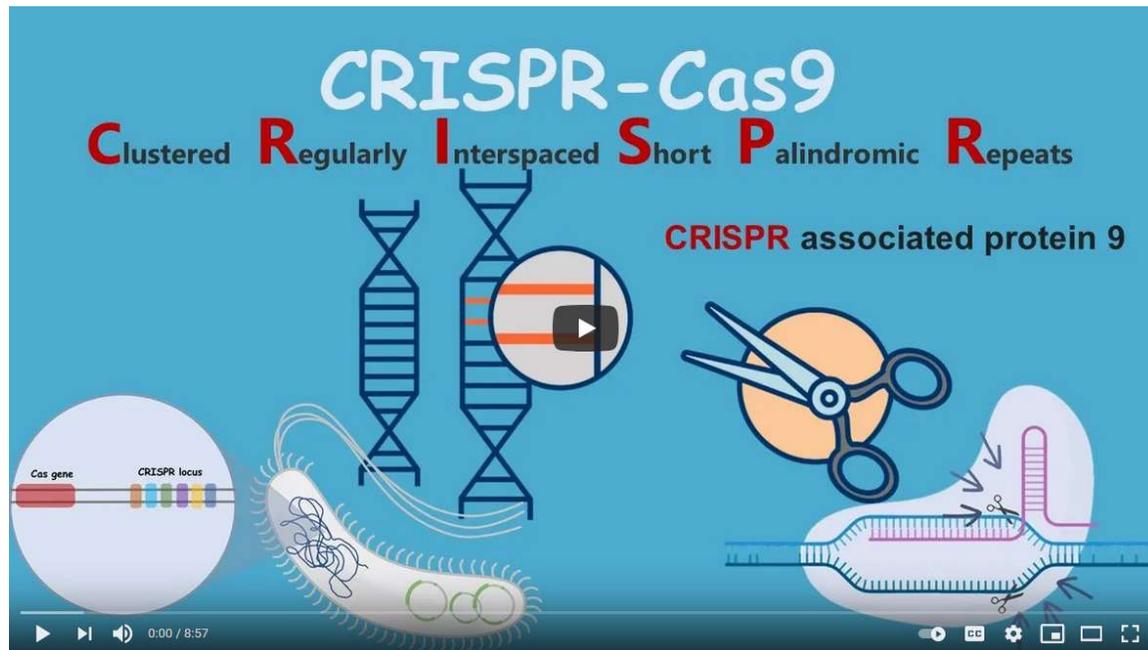
# Embryos, gene sequencing then repair with crisper, gene therapy

Germline gene therapy : introduction of genes into our reproductive cells. Reproductive cells carry an individual's genetic information and pass it onto their offspring



Somatic gene therapy: introduction of genes into the non-reproductive cells in our bodies.

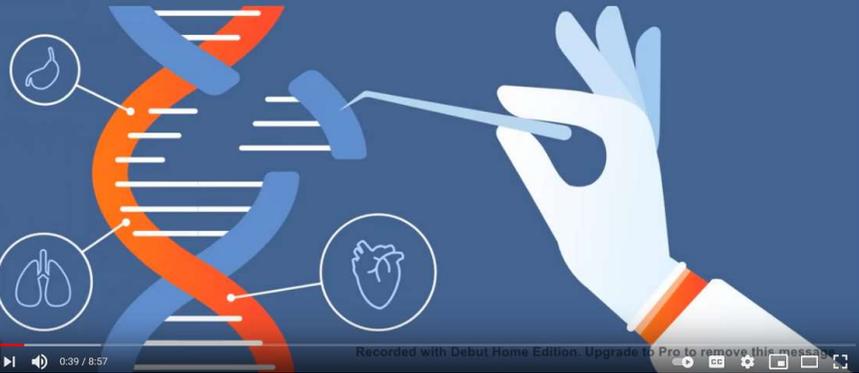
# Genome editing



<https://www.youtube.com/watch?v=qc6xgb4VXI0>

Full seminar on CRISPR <https://www.youtube.com/watch?v=47pkFey3CZ0>

CRISPR allows to perform **targeted alteration** in the genome



Mice, rats, human cell culture,.....

Leukemia : bone marrow  
(edited allograft)

To correct a deficit.

To “enhance” performances (enzymes,....)



*Molecular Therapy*  
In Vivo Excision of HIV-1 Provirus by saCas9 and Multiplex  
Single-Guide RNAs in Animal Models

3 May 2017

Yin et al. use multiplex CRISPR/Cas9 genome editing technology to excise the HIV-1 provirus in a precise manner in three different HIV-1 animal models via *in vivo* AAV gene delivery. The feasibility of HIV excision in infected cells *in vivo* paves the way toward human clinical trials to cure HIV-1 infection.



Dr. He Jiankui

## Human embryos

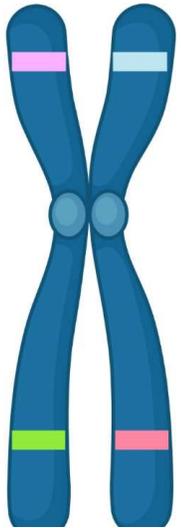
Lulu et Nana, November 2018 HIV.  
In fact not corrective editing

**CONDEMNED**

Condemned to 3 years  
in jail and 380 000€

Scientists  
University of Shenzhen  
Chinese authority  
Justice

Somatic cells and germ cells



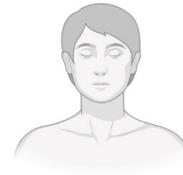
Gene 1

Protein



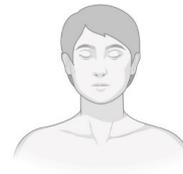
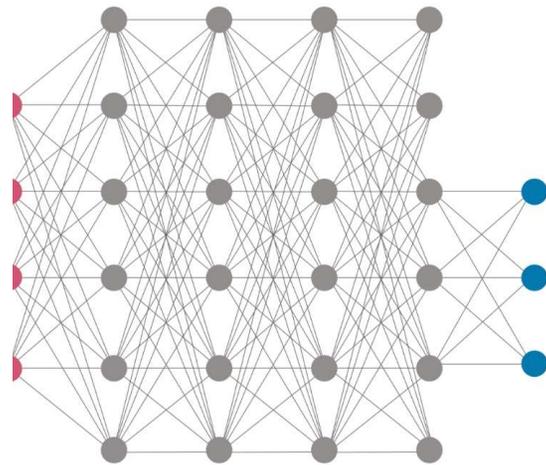
Gene 2

Protein 2



## Direct determinism

1 gene 1 parameter



## Indirect determinism

Several genes 1 parameter  
1 gene several parameters

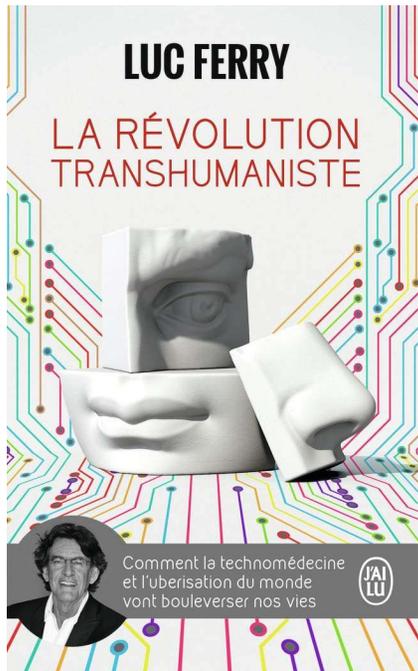
## Transhumanism

Major modification : requires the full understanding of mechanisms that lead to organization of the human embryo.

Not yet there. (3-4 %)

Genetic equilibrium and not an assembly of parameters that can be separately modified

<https://www.forbes.com/sites/cathyhackl/2020/07/05/augmented-human-5-times-ive-used-technology-to-augment-myself/>

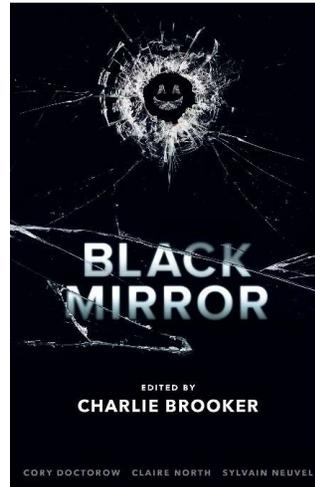


Luc Ferry, La révolution transhumaniste. The death of death ? « La mort de la mort »

Luc Ferry: Philosopher, Minister of education and research

<https://www.youtube.com/watch?v=OXqM7dJVQio>

**SF** : fiction based on imagined future scientific or technological advances and major social or environmental changes.



Started in 2011

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