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Report on Ethical Issues Raised by Emerging Sciences and Technologies

Report written for the Council of Europe,
Committee on Bioethics

by

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Executive Summary

Research and innovation are particularly difficult to govern because they create novelty and surprise. The implementation of technology into society is a complex, open-ended and unpredictable process. The full extent of risks and side-effects can only be known by experience; and by that time they may be irreversible due to their magnitude or their entrenchment into societal infrastructures or human culture. Political and regulatory action accordingly has to include an element of anticipation, acting upon sociotechnical imaginaries, that is, narratives that imagine the future of science, technology and society and their interactions.

Sociotechnical imaginaries have real influence on research practice and policy, and they can be an object of governance. The production of sociotechnical imaginaries has been dominated by scientists, innovators and investors. Lately, however, many European governments, the USA as well as the European Union devote more effort into "soft governance" to democratize the processes of agenda-setting for research and innovation.

Sociotechnical imaginaries can also be taken as early (and uncertain) signals and early warnings. They may warrant monitoring schemes. They may also be taken as worst case scenarios that warrant regulation, such as with human cloning (prohibition) or xenotransplantation (comprehensive safety schemes).

In the report we discuss three sets of scientific and technological developments as paradigmatic cases, labelled as neuro, nano and ICT, respectively. In the full report, we also briefly discuss three cross-cutting aspects: (1) the blurring of the line between the medical and the non-medical domain, (2) the ethical issue of global divides and equitable access and (3) the particular ethical challenges of military use of technologies.

Neuroscience as a Paradigmatic Case for Challenges to Human Identity and Integrity. In 1932, Aldous Huxley published his dystopian novel *Brave New World*. In a remarkable accomplishment of anticipation, Huxley imagined technologies of human enhancement, persuasive technologies and personality-altering technologies. Ethical considerations pertain not so much to essence or novelty as to magnitude, irreversibility, traceability and manipulation, as will be exemplified below.

Human Enhancement. The following technological capabilities are plausible scenarios: Directed and tailored modification of human genetic material in human individuals (germ line); pharmaceuticals and machines (prosthetic limbs and organs) that increase or improve physical, sensory and/or mental capabilities of humans; and devices that establish a functional brain-computer interface, with bidirectional communication.

Genetic modification of human germ line, that is, inheritable changes in human genetic composition, is generally seen as unacceptable and illegal. Still it is unwise not to discuss this possibility in order to take precautions or other measures.

Another important issue is that of fair competition in games, sports and work, including the access to the enhancement, and the right to abstain from or avoid the enhancement. Coercion, social pressure and direct command may threaten the right to abstain or avoid. It would need political action to protect the integrity of the individuals in work life against expectations which muster the ethical weight of the good of the larger number. There is good reason to consider measures to monitor technological developments and continuously evaluate the need for preventive or precautionary measures to protect the right to abstain or avoid in the presence of direct or indirect pressure or coercion.

Persuasive Technologies. We highlight unnoticeable persuasion, such as in Facebook's "emotion contagion study"; enforced persuasion; persuasion on the basis of privileged access to knowledge or other resources; and high-precision persuasion, such as anticipated by neuro-economics and neuro-behavioural sciences. As for the latter, full control of the human brain is unlikely to be achieved. Nevertheless, some precision is likely to be gained to the extent that it might dismantle the conditions for individual autonomy. Scientific ambitions of quantitative understanding, prediction and control of the human mind accordingly should be monitored for this risk.

Personality-Altering Technologies. Coarse personality-altering technologies and techniques have existed for some time. Examples include lobotomy, electroshock therapy, castration, psychoactive drugs, behavioural therapies and, to the extent that they can be called techniques, regimes of violence, containment and torture. Their stated intention have typically been to cure or alleviate mental illness and/or reform criminals, in particular "irrational criminals" such as sexual perpetrators and – in the rationale of authoritarian and totalitarian political regimes – political dissidents.

The emerging sciences and technologies will provide new tools for alteration of personality. The effects of psychoactive drugs are increasingly precise and sophisticated, as witnessed by the popularity of third generation anti-depressants (SSRIs). Their main effect appears to be a dampening of emotional states whereby the magnitude of strong negative and positive emotions is decreased.

In our view, hardly any development within the emerging sciences and technologies causes more ethical concern than that of technology with the potential for personality alteration. The existence of Deep Brain Stimulation (DBS) is a proof in principle of the possibility of dramatic non-disruptive personality-altering technologies. The 20th Century taught the world that authoritarian and totalitarian governments spare no effort in changing the belief structures, desires and personalities of their population. Personality-altering technologies are attractive from the point of view of non-democratic powers. The case made by Huxley in *Brave New World* is that totalitarian power and the pervasiveness of such technologies may reinforce each other synergistically.

It will not be easy to monitor and regulate research and innovation in this field. Prospects of medical applications may justify research. As with psychoactive drugs, however, a function creep may easily occur by which more and more applications are considered legitimate.

Nanotechnology as a Paradigmatic Case for Challenges of Uncertainty and Complexity. The ethical issues of the various parts of nanotechnology are rather different; those closer to the converging

technologies are similar to the ethical issues of biotechnology and neuroscience. Still, there is one general ethical issue, namely that of strict uncertainty and complexity.

Under conditions of uncertainty and complexity, one cannot know in advance whether ordinary procedures of risk assessment and risk management will be able to detect and manage the harms and hazards. Worse, there is no way of ensuring in advance that a real-life situation is not one of uncertainty, ignorance and complexity.

There are two reasons why uncertainty and complexity are particularly important with regard to nanotechnologies. First, there is scientific reason to expect surprising side-effects of nanostructures that cannot be predicted and controlled in advance. It remains to see the extent to which they can be detected early or if we will encounter new "late lessons" similar to asbestos, DDT and thalidomide. Secondly, the scientific belief in control is a leitmotif in the dominant sociotechnical imaginaries of nanotechnology. The nano scientific community actively creates and introduces uncertainty into the world but is by its own thought-style less prone to understand it. How can and should nanotechnology be governed? The Council of Europe may play a role in the development of political and institutional thinking in this regard, devising a framework for such institutions that could improve the safety of citizens, societies and the environment.

ICTs as a Paradigmatic Case for Challenges to Human Autonomy and Privacy. With regard to ICTs and the issues of privacy we highlight three observations, on the convergence of data gathering into so-called Big Data; on the data gathering and storing actors; and on the effect of Big Data on the human condition and the penetration of the life-world by surveillance technologies, respectively.

Convergence into Big Data. With the increasing interconnectedness and compatibility of devices for data acquisition, storage and transfer, comprehensive sets can be made of personal data, covering ever more aspects of personal life. There will be even larger amounts of biophysical/health information monitored by personal health devices, smart clothes and other instances of the Internet of Things. A lot more information can be obtained with a biological sample that can be analysed for DNA structure and protein levels. Furthermore, devices for remote surveillance are becoming more sophisticated. We recommend that more attention is given to the comprehensiveness of this reality, a reality that is more than just the sum of its parts and that is no longer adequately governed by laws and regulations that attend to each individual fields of application.

Who is Watching? In Orwell's novel *1984*, "Big Brother" is the personified embodiment of a totalitarian government. Recent public scandals indicate the development of a type of political regimes that in many respects are constitutive liberal democracies but still develop comprehensive policies of mass data collection upon their own citizens as well as abroad. Clearly, international governance initiatives are needed to come to terms with this situation.

Moreover, large private enterprises, such as Facebook and Google, have mass data collection as the central element of their business model, exactly because a comprehensive data set is of much higher information value than a simpler one. The respect for autonomy and the right to privacy are threatened by this type of business model, and we cannot see that citizens, civil societies or public

authorities have been able so far to decelerate the expansiveness of their mass data collection practices. The magnitude of this challenge calls for coordinated international action.

The Panopticon, Governmentality and the Right to Private Life. What is at stake is the possibility of having an everyday life without being visible all the time. We are reminded of the *Panopticon*, which in Bentham's original idea was a design for a prison. In wealthy countries many surprising health problems emerge: eating disorders, pervasive dissatisfaction with own body appearance and a pathological lack of self-esteem and purpose. The *Panopticon* provided by ICTs is likely to aggravate this situation. It has been argued that the possibility to perform everyday undertakings without being seen, monitored or noticed, may be fundamental to the development of a sane personality. Current developments of convergence into comprehensive Big Data performed by powerful public and corporate actors as well as by the public itself, are a large-scale social experiment in which the right to privacy as a basic element in the human conditions for personality development is at stake.

Implications for the Protection of Human Dignity and Identity, the Right to Integrity, and Other Human Rights and Fundamental Freedoms. *(a) Convention on Human Rights and Biomedicine*[1]*.* The scope of the Oviedo Convention is the application of biology and medicine. Today, almost 20 years after the convention was made, also other sciences and technologies pose ethical challenges to human rights and dignity of the human being. We observe that several of the rights protected by the Oviedo Convention are at stake in the emerging sciences and technologies:

Article 1: Dignity, identity and integrity of all human beings. Identity is threatened individually and collectively by persuasive and personality-altering technologies, and collectively by enhancement technologies that could lead to human speciation events. Identity is also under threat if comprehensive surveillance if conditions for personality development are hampered by the undermining of the possibility of having a private life and exercising the right to privacy. *Integrity* may be threatened by direct and indirect pressure and coercion to subject oneself to enhancement technologies, whereas mental integrity is at stake as collateral effects of personality-altering technologies. *Dignity* is always difficult to define; however, we believe that all of the examples in this paragraph also constitute a threat to human dignity. In particular, enforced or unnoticeable persuasion or personality alteration violates human dignity.

Article 2: Primacy of the human being. This principle is clearly at stake today when governmental and corporate interests perform research and innovation to develop new technological opportunities for mass data collection and persuasion. It is also at stake in experimental research on human subjects for which there is inevitable uncertainty about collateral effects, in particular when performing interventions on the human brain, which is known to be a richly coupled neural network and a priori can be expected to experience side effects.

Article 3: Equitable access to health care. This principle is at stake in global divides such as the digital divide and the nano-divide insofar as technological developments create or change infrastructures that exclude those who do not possess access or knowledge to use the technology.

[1] Convention on Human Rights and Biomedicine (CETS No 164, 1997).

Article 10: Private life. In the Oviedo Convention this principle is invoked with respect to health information. What can be learnt from the emergence of mass data collection, Big Data and the blurring of the line between the medical and the non-medical, is that more than just health information as conventionally understood can be critical for the possibility to exercise and uphold a private life. Indeed, already a payment card or a smart power meter, if unregulated, can undermine this right.

(b) Convention for the Protection of Human Rights and Fundamental Freedoms[2]. Below we briefly comment on the relevance of two articles that present a larger range or scope of human rights and freedoms than immediately visible in the Oviedo Convention.

Article 8: Right to respect for private and family life. We observe that this right is not limited to the scope of biology and medicine but applies generally. Specifically, there may be an exception for the necessity of the economic well-being of the country, which is no carte blanche to mass data collection as a business model for multinational corporate interests.

Article 9: Freedom of thought, conscience and religion. Often, the article is invoked when the right to manifestations of these freedoms is violated. However, as we have explained above, the right to freedom of thought and conscience itself, that is, freedom from interference and intervention on cognition and brain processes, is indeed at stake in the development of persuasive and personality-altering technologies.

Recommendations

(1) The developments within emerging sciences and technologies pose serious ethical issues and concerns. The Council of Europe has an important role also in being a forum for continuous reflection and discussion needed to root the answers to the new ethical issues in shared European values and shared criteria for action. The scope of the bioethical work of the CoE should be permanently expanded to cover the developments in nano-, neuro-, info- and cogno- science and technology. One option would be to expand the mandate of the existing committee on bioethics to a committee on the **ethics of science and technology** (in a similar vein to the COMEST committee of UNESCO).

(2) Better governance is needed to increase the ethical and social robustness of new and emerging sciences and technologies. Such robustness can only be achieved if the public is included in the processes of governance. In line with the European heritage of democracy, a significant task for bioethical work is to play a proactive part in the democratization of the production of sociotechnical imaginaries and thereby our common scientific and technological future, for instance by developing and encouraging participatory foresight exercises, upstream engagement and other practices of what has been called “responsible research and innovation” (RRI).

(3) In our report, we have observed threats to several fundamental rights and freedoms laid down by the Oviedo Convention as well as the Convention for the Protection of Human Rights and

[2] CETS No 5, 1950.

Fundamental Freedoms. A number of possible ways forward can be imagined, including new Recommendations on specific technological fields. We would like to propose, however, that the Council of Europe also considers the possibility of establishing a new convention for ethics of science and technology in general, beyond the bioethical domain in a strict sense and with a wider scope of ethical issues. We have indicated the main fundamental rights and freedoms that we believe to be at stake.

(4) Another way forward is to discuss how measures can be taken when the normative basis and the legal instruments are present, but new practices in the world of science and technology are seen to systematically violate them. For instance, the report has raised the question if not the new phenomenon of mass data collection and surveillance as a business model indeed is a violation of fundamental rights and freedoms of citizens.

(5) Several technological fields call for continuous monitoring with respect to the ethical issues they pose. This includes human enhancement, persuasive and personality-altering technologies and other technologies that interfere with the preconditions for enjoying fundamental rights and freedoms. CoE is encouraged to take a proactive role in the development and harmonization of such ethical monitoring schemes and practices.

1. Introduction

Modern science was born in Europe in the 16th and 17th Century. The vast potential of knowledge and technology to change the human condition was anticipated from its early days. Francis Bacon famously stated: "Human knowledge and human power come to the same thing, for where the cause is not known, the effect cannot be produced"[3]. In the vision of Bacon, his contemporaries and his successors, Science held the key to a new world in which the wild forces of Nature were domesticated and humanity prospered; a world of "generosity and enlightenment, dignity and splendour, piety and public spirit"[4]. The Utopian hope for science and technology was reiterated and reinforced during the Enlightenment, promising a society of welfare, equality, justice and happiness[5].

In the latter half of the 19th Century and throughout the 20th Century, modern science and technology came to fulfil many of the old visions and hopes. Human understanding and technological command over Nature have reached a level unthinkable for our predecessors. Health and medicine; food and nutrition; production and supply of energy; housing and transportation – these are but some examples of sectors and functions in our societies that have been repeatedly transformed as science and technology developed ever faster during the 20th Century. At present, early in the 21st Century, new scientific disciplines and research fields are emerging, such as nanoscience and nanotechnology, neuroscience and cognitive science, systems biology and synthetic biology. Other fields have a longer history but appear to have entered a stage of rapid and qualitative progress, such as robotics and information and communication technologies. Finally, there are immense research efforts undertaken to combine and converge the insights from the various sciences into the so-called converging sciences and technologies. History justifies us to expect innumerous benefits for humankind resulting from these efforts and developments.

In the 20th Century, however, History also taught humankind that with the great powers of modern science and technology comes great responsibility. The lessons were several: the need to develop international governance to cope with the challenges of nuclear power; the impacts of modern societies and their technologies on the natural environment and the climate; and the implications of biomedicine and biotechnology for human reproduction, health, identity and dignity. What Mary Shelley anticipated already in 1818 in her novel *Frankenstein, or the Modern Prometheus* was gradually understood and accepted in the second half of the 20th Century: That also the passion for knowledge needs to be tempered by ethical sense and rational assessment and management of its consequences.

The loci of ethical and rational temperance are and ought to be many. States have an undeniable responsibility for the safety and security of their citizens. Scientific actors and institutions are subject to national regulations and guidelines, as well as having strong traditions of self-governance on the

[3] Francis Bacon (1620/1994), *Novum Organum; with Other Parts of the Great Instauration,* Chicago: Open Court Publishing.
[4] Francis Bacon (1627), *The New Atlantis.*
[5] See for instance Marquis de Condorcet (M. J. A. N. de Caritat) (1796), *Outlines of an Historical View of the Progress of the Human Mind.* Philadelphia: Lang & Ustick.

basis of their own professional ethos. Finally and ultimately, individual human beings are also their own moral subjects with their own liberties and responsibilities as individuals and citizens for their individual and collective quality of life. Many of the ethical and political aspects of the risks and benefits of modern science and technology will rightfully be seen as concerns of individual choice, market mechanisms, institutional governance and national politics.

Still, however, there are scientific and technological developments of such vast dimensions and implications that international coordination and action is called for. While the agency of the individual is essential in the unfolding of her or his life, it is Society's responsibility to secure the conditions for individual agency to be possible. Accordingly, modern societies have not only sustained a two century long *discussion* of the benefits and hazards of the technological developments. Visibly risky technologies – e.g. for warfare and destruction – have a long history of governmental regulation. The regulation of the ethical, legal and societal aspects of more indirectly hazardous technologies has sometimes been more demanding. It has taken a greater intellectual effort to interpret the developments, identify and understand the issues at stake and develop adequate societal responses. Modern biotechnologies provide a case in point. While the benefits they offer are many, the issues at stake have been seen to run deep into the very core of what constitutes humanity and the identity of the human species. Consequently, nation states and leading international organizations have all developed their legal and/or ethical frameworks to cope with the challenges posed by modern biotechnology. In this sense, this report marks nothing new in principle. Its objective is not to change how science and technology is understood by modern societies – as a provider of benefits and hazards; as a strong piece in the game but also a game changer – but merely to direct the ethical attention to new fields of science and technology, fields that are marked by rapid development that so far have not been much subject to ethical scrutiny.

In short, conditions fundamental to the human condition may be at stake as science and technology advance. Hence, the Council of Europe expressed by the Convention on Human Rights and Biomedicine[6] (the Oviedo Convention) its commitment to:

> *[…] protect the dignity and identity of all human beings and guarantee everyone, without discrimination, respect for their integrity and other rights and fundamental freedoms with regard to the application of biology and medicine. (Article 1)*

Soon 20 years will have passed since the achievement of the Oviedo Convention. Science has made tremendous developments during these two decades. As noted above, new fields of research have come into existence. Other sciences merge with biomedicine. In society, the line between the medical domain and the non-medical (work, leisure, commerce and government) is being blurred. It is our claim that the ethical challenges posed by these developments to some extent differ and exceed those of the early days of human biotechnology, genetic engineering and cell biology. As shown by the Rathenau Institute in their report *From Bio to NBIC convergence – From Medical Practice to Daily Life*[7], the range of ethical issues is increasing and so is the range of domains where

[6] CETS No 164, 1997.

[7] Rinie van Est et al. (2014), *From Bio to NBIC convergence – From Medical Practice to Daily Life. Report written for the Council of Europe, Committee on Bioethics. The Rathenau Institute, the Hague.*

they apply. Below, we argue that fundamental rights and freedoms may be threatened in new ways that call for new measures of protection. The Rathenau report essentially claims that the issue at stake in the development of new and emerging technologies is the identity of the human species and human life itself, including the possible blurring and convergence between machines and living organisms, including humans. It proposes that contemporary societies become aware and prepared to ask which human traits we wish to pass on to future generations.

No single institution have, or could take, the responsibility for questions of this magnitude. Reflection, discussion and action are all needed at a number of levels: the individual, the family, the community, the market, our societies – and clearly the sectors of science and technology themselves. The Council of Europe and its Committee on Bioethics may play, and already plays, a proactive role at several levels. First, it is a forum for continuous reflection and discussion that contributes to anchor the answers to the new ethical issues in shared European values. In this way it may make an important contribution to meet the dire need for a deep *understanding* of the rapid developments, an understanding that may lead to identify needs for *action* also at a national or sectorial level as well as shared criteria for such action. As a champion of the European heritage of democracy, the Council of Europe may through its activities in the bioethical field contribute significantly to the creation and development of proper political attention to the emerging ethical issues among governments, in citizenries and in the governance of science and technology.

Moreover, the centrality of the Oviedo Convention in later governance and practice of science and technology has shown that the Council of Europe is in a key position to approach the need for international governance and legal developments. Being philosophers of science and ethicists, we do not possess the expertise required to analyse possible legal measures that could be taken, such as a revision of the Oviedo Convention or the preparation of a new convention. We shall, however, state the needs for new measures as they follow from our analysis of the ethical challenges, and humbly suggest some ideas for action for the DH-BIO to consider.

2. Ethical Issues Raised by Emerging Sciences and Technologies – What is at Stake?

Emerging Sciences and Technologies – Realities and Imaginaries

This report is one on *ethical issues.* As there is a plurality of ideas on what ethics is and how it should be practised, we begin by clarifying our own methodology. First, we have considered our task as one of *identifying and clarifying ethical issues* rather than passing verdicts on specific technologies or decision problems. This report will not "apply" substantive ethical principles – e.g. consequentialist or deontological principles and analyses – to condemn or acquit certain technologies or their use. Instead, our approach is grounded in a discourse ethics position. Our task is to *show what may be at stake* in various issues from various angles, notably from a human rights perspective that will encompass both typically utilitarian concerns of risks, hazards and benefits, and concerns more akin to those of duty and virtue, in technological developments that appear to destabilize fundamental categories of human dignity and identity. In this sense the report may be charged with eclecticism. Our justification for this choice, however, is rooted in a reflection upon our role and the role of the DH-BIO. We provide an overview and our judgments on what are the important issues. It is the role and competence of the DH-BIO to decide how to move forward with these issues of novel science and technology, to make its contribution to the responsible governance of research and innovation.

We would also like to stress that this report deliberately focuses on *ethical concerns.* The emerging sciences and technologies are likely to provide numerous benefits to mankind and our natural environment. Responsible governance that deals thoroughly and proactively with potential hazards and other ethical concerns, is the best strategy in order to promote the positive developments to be expected. The function of this report is to scrutinize the field and bring the potentially problematic development to the fore. This methodological emphasis should not in any way be interpreted as a judgement on the future of the emerging sciences and technologies as a whole.

Research and innovation represent two sectors of society that are particularly difficult to govern. There are two reasons for this. First, competent governance of the societal implications of science and technology may require knowledge and understanding of the content of the same science and technology. As the research forefront moves with accelerating pace, such knowledge and understanding may be difficult to obtain. Secondly, these sectors are by their definition creators of novelty, surprise and unpredictability. A famous jazz musician, when asked by a journalist, is supposed to have responded "If I knew the jazz of the future, I'd play it"[8]. This paradox is equally applicable to science, research and innovation. In the regulation and governance of technology a variant of this paradox was called the "Collingridge dilemma": The implementation of technology into society is a complex, open-ended and unpredictable process, and risks and side-effects cannot always be anticipated. When the risks and side-effects finally are known, they are known because they are

[8] Edward Tenner (1996) *Why things bite back: technology and the revenge of unintended consequences.* New York: Alfred A. Knopf, p, xi.

being experienced; and by that time they may be virtually irreversible due to their magnitude or their entrenchment into societal infrastructures or human culture. The private car is an excellent example of the Collingridge dilemma.

This means that governance of science and technology is bound to be outdated and too late if it merely responds to concrete realities in the form of well-established technological applications existing in use and in the market. Political and regulatory action have to include an element of anticipation, acting upon what does not yet exist but what is thought to be the science and technology of the future. Indeed, due to the rapid pace of development, there is not only a time lag in political and regulatory action, but already also in the interpretation and understanding of the development. Sometimes, new things are *made* faster than they are *understood:* Making, however sophisticated, may be a limited task of design and assembly, while understanding requires knowledge of the myriads of interactions between the new thing and numerous other elements in nature and culture.

The science and technology of the future is an even more peculiar object to take into account in governance. It is not material as such (while of course preliminary research results or technology pilots may be material). Rather, its mode of existence is that of individual and collective *mental constructs* for which there is an important element of *imagination.* Indeed, scholars of the interdisciplinary research field of Science and Technology Studies have convincingly argued that research policy as well as research practice are heavily dependent upon *sociotechnical imaginaries,* that is, narratives that imagine present and future society, present and future science and technology, and how they interact. The bioeconomy; the transformation of chemical industry by nanotechnology; the automation of the health sectors by personal autonomous robots; an ICT future with "a computer on every desktop" – these are all forceful examples of sociotechnical imaginaries that have had major impact on European research policies during the latter decades. Some of these imaginaries die away, others change, and others are translated into action that shapes concrete material reality. What is crucially important for an improved governance of science and technology is to understand that sociotechnical imaginaries are both real and important and not dismiss them as "science fiction". Sociotechnical imaginaries are a constitutive part of any understanding of science and technology from which one may make ethical, political and regulatory judgments. We cannot emphasize too strongly that imaginaries implicitly play a direct role both in ethical action and R&I action, and for that reason they should be reflected upon.

From the point of view of governance of science and technology there are therefore two important approaches to sociotechnical imaginaries.

First, their existence should be treated as an *empirical matter of fact.* The Thomas Theorem of social science and psychology states that "what men perceive as real, is real in its consequences". The Thomas Theorem applies to sociotechnical imaginaries: They have real influence on research practice and policy. For instance, the history of technology is ample with examples of interesting technological possibilities that failed to be championed by convincing imaginaries or experienced a setback so that public, political and scientific trust in the imaginary could not be recovered for a long time. The Zeppeliners are one such example; Tesla's lightning power stations another. The reality of imaginaries means, however, that they can be an object of governance. Whereas the practices of

developing, formulating and promoting sociotechnical imaginaries so far have been dominated by scientists, innovators and investors, they need not necessarily be so. Many European governments, the USA as well as the European Union have accordingly devoted ever more effort into so-called upstream public engagement with the objective of expanding the participation and democratizing the processes of agenda-setting for research and innovation. Such efforts have become increasingly institutionalised. For instance, the 8th framework programme for research and innovation in the European Union ("Horizon 2020") includes the concept of Responsible Research and Innovation (RRI) as a cross-cutting principle in order to make R&I more responsive to social needs and goals.

As often is the case, however, it is not only the object of governance of science and technology that is complex. The current developments of governance itself are rightly described as complex, and sometimes described as governance *in* complexity rather than *of* complexity. The strengthened position of efforts grounded in ethics, such as RRI, upstream public engagement and the democratization of agenda-setting for research and innovation, has taken place in parallel with an increased instrumental focus in the same countries whereby research policies are also focusing more on innovation, economic growth and job creation. This should be seen as a consequence of the financial crisis that hit European countries in later years.

At times, these complexities may take the shape of an apparent competition between the "softer" concerns about ethics and the "harder" economic concerns and interests. This tension has also been accompanied at times by a distinction between "softer" forms of governance, encouraging actors to take ethics into account, and "hard" governance in forms of binding law and regulations. What we see observe in later years, however, is the opportunity to overcome the distinction between soft and hard governance. One general development that has been noted in several countries is that ethics has become more law-like and law more involved in ethics. For instance, EU's "Responsible Research and Innovation" is both a set of practices for the various societal actors to take part in and develop, and in effect a legal principle passed by the European Parliament. Likewise, the UNESCO Declaration on Bioethics includes principles such as those of *solidarity* and *cooperation.* The Council of Europe, as a champion of the European heritage of democracy and human rights, have an important role to play in these developments.

At the same time, there is still a legitimate and important domain more proper to "hard" governance, concerning regulations of use, prohibition and permission, monitoring schemes for risk and harm, et cetera. The second approach to the sociotechnical imaginaries is to treat them as *early signals and early warnings*, that is, to be used in foresight exercises as predictive information of the actual science and technology of the future. As such, this is inherently uncertain and unreliable information and there is no mature research-based knowledge for how to best interpret and manage it. Whether such knowledge may be developed, is also uncertain – it is essentially a question of the degree of inherent creativity and unpredictability of various fields of science and technology. Still, this does not preclude the possibility of governance, even hard governance. Early warnings based on imaginaries may very well warrant monitoring schemes that may be voluntary or required by law. They may also be taken as worst case scenarios that in themselves may warrant legislation and regulation, such as with human cloning (prohibition) or xenotransplantation (comprehensive safety schemes). In our opinion, this latter approach also clearly falls within the domain proper of the Council of Europe, as shown by previous accomplishments.

Our discussion builds directly on the report *From Bio to NBIC Convergence,* written by the Rathenau Institute for the DH-BIO, as well as the field of research into the ethical, legal and societal aspects (ELSA) upon which the Rathenau report builds. A key point in that report as well as in the literature in general is the trend towards convergence between the bio, nano, neuro and ICT fields, together with mechatronics and robotics. This convergence in its turn causes entanglement of the ethical issues that has been considered typical for each of these scientific and technological fields. A main point in the work of the Rathenau Institute is their emphasis on two so-called mega-trends: That machines become more similar to organisms, and that organisms (including humans) become more similar and more coupled to machines. The Rathenau report raises the question if this implies a need for new ontological and ethical categories if we are to understand and govern well.

We are sympathetic to this claim and believe it deserves thorough attention in ongoing reflection, discussion and debate. Still, we have adopted a different methodology in what follows, which may be described as a more incremental approach, trying to describe and interpret the emerging challenges in light of existing categories of ethical issues. In this way we have tried to identify issues that seem to be well managed by existing ethical frameworks as well as and issues that call for an extension of the frameworks. The disadvantage of our approach is that we may lose some complexity from sight. The advantage is that our conclusions may be easier to implement in practice. This methodological choice should be part of the discussion that will follow the report.

Specifically, we have found it useful to organise our discussion into seeing three sets of scientific and technological developments as paradigmatic cases, labelled as neuro, nano and ICT, respectively. Each of them will be analysed in terms of what we have found the most pertinent concern – that of priority challenges to human rights. In the final part of the report, we will return to these challenges.

Following these three main topics, we will briefly discuss three cross-cutting aspects that are equally relevant for the various S&T fields. The three are (1) the blurring of the line between the medical and the non-medical domain, (2) the ethical issue of global divides and equitable access and finally (3) the particular ethical challenges of military use of technologies.

Neuroscience as a Paradigmatic Case for Challenges to Human Identity and Integrity

> *O wonder!*
> *How many goodly creatures are there here!*
> *How beauteous mankind is!*
> *O brave new world,*
> *That has such people in't!*[9]

More than 80 years have passed since Aldous Huxley published his dystopian novel *Brave New World,* whose title alluded to Miranda's ironic praise when she came to know society in *The Tempest.* In a remarkable accomplishment of anticipation, Huxley imagined technologies of human enhancement, persuasive technologies and personality-altering technologies.

Such technologies have to some extent and in some form been present for a long time. Alcohol, for example, may in principle be regarded as having both persuasive and personality-altering agencies. Many drinkers of coffee or other drinks containing caffeine experience an enhancement effect both physically and mentally. Ethical considerations accordingly pertain not so much to essence or novelty as to magnitude, irreversibility, traceability, manipulation, in short, the specific details of such technologies.

Furthermore, we do not claim that enhancement, persuasion and personality alteration are the only ethically relevant aspects of neuroscience and neurotechnology. There are of course a number of other aspects, such as safety, liability, informed consent et cetera. Still, we believe it is the set of issues alluded to by *Brave New World* that deserves major attention. We will discuss them in turn.

Human Enhancement

The technological promise of "human enhancement" is on one hand as old as Bacon's *The New Atlantis*, and on the other hand a recent concern in the ethics debate, notably after the development of recombinant DNA technologies suitable for genetic engineering. On the basis of what already exists and on what is regarded as likely future development (i.e., treating current imaginaries as early signals), we recommend that at least the following technological capabilities are regarded as plausible scenarios:

- Directed and tailored modification of human genetic material in human individuals (germ line)

[9] William Shakespeare (1611), *The Tempest,* Act V, Scene 1

- Pharmaceuticals and machines (prosthetic limbs and organs) that increase or improve physical, sensory and/or mental capabilities of humans
- Devices that establish a functional brain-computer interface, with bidirectional communication

Such developments are described in detail elsewhere, including the Rathenau report *From Bio to NBIC Convergence.*

There is no consensus on the ethical status of human enhancement as such. In the literature, one can find everything from general opposition to technologies that enable human enhancement to those who embrace it in an ideology of "transhumanism". We would like to propose that ethical discussions on technologies of human enhancement (and indeed emerging technologies in general) are made more *ethically specific.* From a discourse ethics perspective, acknowledging the legitimate plurality of moral values, it seems clear that no decisive argument has been made (or can be made) for or against human enhancement as such and *in toto*. Rather, one should ask for the *ethically relevant features* of the technology.

Focusing on the ethically relevant features, some observations should be made.

First, genetic modification of human germ line, that is, inheritable changes in human genetic composition, would be a practice contrary to all guidelines we are familiar with and probably illegal in most countries. Still it is unwise not to discuss this possibility in order to take precautions or other measures. Its illegality does in no way preclude its possibility of taking place somewhere at some time. Silver Lee's prediction *Remaking Eden* of a future speciation process by which there may be reproductive barriers between modified and non-modified humans should be taken seriously; indeed, what will prevent it is not so much technological barriers as the work of political institutions within and between nations.

A second observation is that *enhancement* is a normative concept and most applications will have a mixture of intended and collateral effects, all of which may be ambiguous by their nature. For example, there are pharmaceutical and neurological attempts to "enhance memory". If an individual experiences an increased ability to recall memories, we may of course speak of enhanced memory. Whether this is "human enhancement" or not, is a matter of definition. One may imagine a person who will compete well in games or at work. One may, however, easily imagine that extremely detailed or persistent memory skills may interfere with the overall personality, communication skills and well-being of the person. Although causality remains unknown, it is well-known that some persons diagnosed on the autism spectre can outperform most normal individuals at e.g. memory games. From the perspective of evolutionary biology one may argue that extreme performance in a few specific mental skills involves a risk of disrupting the overall balance in individual personality.

This ambiguity of "enhancement" has been noted with respect to deep brain stimulation (DBS), which should be treated as a reality and not as science fiction. DBS exists and is in use. It is performed with a specific (therapeutic) intent but empirical experience shows that unpredictable collateral effects are the rule and not the exception. As we will return to in the section on nanotechnology, collateral effects, ambiguity and unpredictability *are to be expected,* and this is ethically relevant because it must be assumed that the fate of trial subjects cannot be fully evaluated

or controlled in advance. In the case of DBS and other brain technologies, one may even support this principle scientifically. Whereas neuroscience has shown a fairly good correlation between certain mental functions and certain anatomical parts of the brain (e.g. “speech centres” et cetera), there is ample evidence of individuals who gradually recover functions such as speech and memory after brain damage. Recovery of speech shows that the brain is a self-organizing, adaptive system capable of spontaneous re-wiring. Recovery of lost conscious memory shows something more, namely that the brain is a neural network where function to some extent is delocalised: (virtually) everything is (virtually) everywhere. By implication, localised intervention such as DBS is likely to affect several functions.

Next, there is the issue of fair competition in games, sports and work – the case of the athlete Oscar Pistorius already being a paradigmatic reality. Pistorius, a double amputee, runs with two prosthetic limbs. What is noteworthy in this case is the controversy around the function of these limbs: Whether they merely compensate for his physical handicap or give him a competitive advantage with respect to normal athletes.

It seems unlikely that general substantive principles can be developed to arbitrate on the specific, concrete questions on fair competition. The world of sports and games has its own norms, rules and institutions to govern these questions which continuously increase in number and complexity. In civil society, it should be noted that human traits are not constant between generations, both as a result of technology and other, sometimes not fully understood, processes. What is clear, is that in many parts of the world, humans live much longer, enjoy a better health (by most criteria) and have a different physical appearance (notably they are much taller) than their predecessors only two centuries ago. As a consequence of better technology but also more knowledge, better education, et cetera, it is also not unreasonable to state that many contemporary humans have better physical, mental and sensory capabilities than their predecessors. This does indeed affect competition at work and in society. For instance, the prevalence of dyslexia has increased not because reading speed has decreased but because demands and standards of reading speed have increased.

In sum, the ethical concerns may not so much be the enhancement technology as such, but the fairness of competition, the access to the enhancement, and the right to abstain from or avoid the enhancement.

The right to abstain from or avoid the enhancement is a particular ethical concern, in particular when there are collateral effects that are negative, ambiguous or uncertain. As noted above, in the case of neurotechnologies and other applications of neuroscience, one should *a priori* assume that there can be such collateral effects. Coercion, social pressure and direct command may threaten the right to abstain or avoid. For instance, it is known that soldiers under command have tested enhancement drugs such as modafinil which is intended to reduce the physiological need to sleep.

The example of soldiers on experimental drugs is perhaps extreme (although realistic). More subtly, we expect many dilemmas to be arising when enhancement is expected for the sake of the greater societal good. An example may be in the work domain, expectations to professionals. Take airline pilots as example. It is easy to imagine a scenario where the existence of sensory enhancement techniques, and/or techniques which improve stress resistance and crisis management could become the norm for the airlines when hiring their pilots. The argument would be the trade-off between

increased safety for the large number of passengers against the (harmless?) alteration of performance expectations of the pilots. There could even be a large pressure from the customers, society at large, that airlines make use of these technologies. The voluntariness in most arenas of life of such enhancement drugs would be trumped by them being conditional for certain professions. The underlying difficulty is of course the concept of normal performance and of reasonable expectation to performance given the large stakes dependent upon it. However, we do not believe that the mere fact that form and content of "normal performance" has changed over time and is still changing, makes it impossible to delineate it from expectations towards outstanding performances only achieved through mediating technologies based upon some kind of (physical or other) intervention. It would need political action to protect the integrity of the individuals in work life against expectations which muster the ethical weight of the good of the larger number.

A similar situation may occur more hidden from the public view in implicit expectations in institutions which aspire to the status to be elite institutions. Some schools of higher learning may already be an example of this. Though not prescribed explicitly, the expectations to performance may be such that they can only be achieved through enhancement. It is noticeable that such outstanding performances (e.g. in study) usually are not correlated to the quality of the outcome. Monks in medieval monasteries may have achieved a higher quality of learning than prime all-A students in elite modern institutions of learning. However, as long as expectations are merely implicit they may not be the subject of regulation, only of ethical deliberation and reflection.

We believe these examples provide a good reason for considering measures to monitor technological developments and continuously evaluate the need for preventive or precautionary measures to protect the right to abstain or avoid in the presence of direct or indirect pressure or coercion.

Summing up the above considerations, "human enhancement" as a concept as such may not be the most relevant locus of ethical action. The scenario of speciation processes, with the social consequences that it may imply, is ethically and legally relevant and it is already included in the scope of existing guidelines and legal frameworks. The issue of fair competition and equal access is well developed in sports and games, and less in work and civil society. The right to resist pressure or coercion to accept a human enhancement technology is not sufficiently protected.

Persuasive Technologies

The art and craft of verbal persuasion is old. Written sources that reveal an understanding of rhetoric date back more than 4000 years, to the Akkadian Princess Enheduanna. It is possible to describe a line of continuum from Ancient rhetoric to 20th Century marketing science and 21st Century persuasive techniques and technologies. Within this line, a set of legal and ethical norms and principles provide criteria for what is prohibited; legal but not morally justified; and legal and morally justified. While the exact set of such norms and principles differ between times, nations and cultures, in particular with reference to the balance between them and the right to freedom of speech, some ethical principles are timeless: honesty, truthfulness, transparency, benevolence, non-malevolence,

and respect for autonomy. Inherently there is a tension and a trade-off between the respect for the others' autonomy and the right to pursue one's own goals by trying to persuade others.

We wrote above, when discussing enhancement technologies, that instead of discussing technologies as such and *in toto*, the attention should be focused on ethically specific features. A general discussion of the moral value of persuasive technologies as such is not likely to be fruitful. The relevant discussion with respect to emerging sciences and technologies is to what extent they provide knowledge and technology that represent a departure from the historical continuum either by essence or by degree. We believe that there are aspects that represent such a departure, notably:

- Unnoticeable persuasion
- Enforced persuasion
- Persuasion on the basis of privileged access to resources
- Persuasion on the basis of privileged access to knowledge
- High-precision persuasion

Unnoticeable persuasion has been discussed for more than 50 years, since James Vicary claimed that he had carried out a successful experiment with subliminal advertising during a cinema performance. Subliminal visual or auditory stimuli are stimuli of which the exposed person remains consciously unaware, either because their duration is very short or they are otherwise masked, such as when signs have been given an intentionally peripheral placement. Vicary's claims are generally regarded as fraudulent and there appears to be little scientific evidence that subliminal advertising can change customer preferences. There is, however, evidence in support of the effects of subliminal messages on emotional state and performance. There are empirically based claims that subliminal messages may make people more content, prone to act upon their preferences, relaxed or self-assured.

The latter few years a new type of unnoticeable or hardly noticeable persuasion has been invented. Service providers on the internet, such as Facebook and Google, collect data on users' internet behaviour and use this information to tailor advertisements but also other content in their services. Facebook's "emotion contagion study", published in 2014[10], shows how a social media provider may succeed in mass manipulation of emotions. This research project did not obtain informed consent from the 700,000 research subjects and is rightly condemned for disrespecting the autonomy of the participants. An interesting response is that of the artist and programmer Lauren McCarthy who has developed a programme extension called "Facebook Mood Manipulator". This application allows individual users of Facebook to influence the tailoring of content according to their own preferences for emotional manipulation. In this way the artist highlights the potential for unnoticeable manipulation and the inherent deficit in transparency and respect for autonomy in content-tailoring internet services. It is reasonable to expect technological developments by which such mechanisms become even subtler and more pervasive.

[10] Adam D. I. Kramer et al. (2014), *Experimental evidence of massive-scale emotional contagion through social networks,* Proceedings of the National Academy of Sciences of the United States of America, 111(24):8788-8790.

Finally, it would be unwise not to prepare for the possibility of unnoticeable pharmaceuticals or non-invasive neurological technologies based on electromagnetic radiation that may affect brain processes in real time. *We believe that the ethical challenges would be similar to those of subliminal stimuli and content-tailoring, and that both research and the regular use of such application call for regulatory action, including the possibility of prohibition.*

Enforced persuasion and persuasion on the basis of privileged access to resources. Not unrelated to personality-altering technologies (see below), by enforced persuasion we refer to enforced exposure to persuasive technologies. Low-tech examples of this can be found in many places in the world, such as when public spaces and pathways (e.g. airport entrances) are filled with advertisements, and when political and ideological propaganda holds an important place in the curriculum or activities in mandatory education of children. A similar situation is encountered when a private or public entity enjoys a monopoly or dominating position in the market or society, making it very hard for customers and citizens to avoid the attempts of persuasion. This is why manipulation by market leaders such as Google and Facebook may be so powerful. Governmental and market power is therefore a relevant ethical criterion with respect to persuasive technologies.

Persuasion on the basis of privileged access to knowledge. Already the Sophists of Ancient Greece knew that the art and craft of persuasion can be acquired by education. Since then, marketing science has developed into a highly sophisticated research discipline of which lay people can only have rudimentary knowledge. The more specialised the body of knowledge, the larger the threat to transparency and the right to autonomy. Already this represents a threat to democracy, as when political campaigns are informed and tailored on the basis of continuous polling and the application of marketing science.

With the advancement of neuroscience we also observe the emergence of new research fields such as *neuroeconomics.* Even without novel electromagnetic devices to influence brain processes, it is reasonable to imagine that neuroscience in the field of neuroeconomics will provide fundamental understanding of the neurological basis of human decision-making, which indeed is the stated goal of that sub-discipline. It is difficult to see how such knowledge would not create novel opportunities for persuasion and manipulation. Those who master this knowledge might be able to discover and resist attempts at manipulation; however, they are likely to be a minority unless the development and use of such knowledge somehow is regulated, and the majority in addition becomes scientifically literate in these fields. We speculate, however, that a society in which everybody is an expert on sophisticated principles and techniques of manipulation, may not be a desirable society.

High-precision persuasion. According to current belief, subliminal advertising cannot change customer preferences. It can only influence the impulse to act upon the individual's own, authentic preferences. Marketing campaigns, on the other hand, may change preferences and opinions by persuasion, still fallibly and indeterministically.

The stated goal of neuroscience and its applied fields such as neuroeconomics is to advance our understanding of the human mind from a largely descriptive state to becoming an exact science on a par with physics, chemistry and the molecular life sciences. This is also the rationale for its interaction and convergence with the other exact sciences. To become an exact science implies the potential of being applied into an engineering discipline. As indicated above, there is good reason to

believe that full prediction and control of the human brain cannot be achieved. This does not preclude, however, that some precision is to be gained[11]. Such a development would not only constitute disrespect for individual autonomy; it would in effect dismantle the conditions for individual autonomy. Scientific ambitions of quantitative understanding, prediction and control of the human mind accordingly should be monitored for this risk.

Personality-Altering Technologies

Coarse personality-altering technologies and techniques have existed for some time. Examples include lobotomy, electroshock therapy, physical and chemical castration, the intended and unintended effects of a number of psychoactive drugs, behavioural therapies and, to the extent that they can be called techniques, also regimes of violence, containment, torture, concentration camps et cetera. Their stated intention have typically been to cure or alleviate mental illness and/or reform criminals, in particular "irrational criminals" such as sexual perpetrators and – in the rationale of authoritarian and totalitarian political regimes – political dissidents, who typically were seen as criminals, mentally ill, or both. A dystopian literary reference is Anthony Burgess' *A Clockwork Orange,* in which the protagonist Alex is subjected to the "Ludovico Technique", an exposure-correction treatment to cure his violent tendencies.

The emerging sciences and technologies will provide new tools for alteration of personality. The effects of psychoactive drugs are increasingly precise and sophisticated, a witness of which is the vastly increasing popularity of third generation anti-depressants (SSRIs). In some countries, these drugs are in regular use by a noticeable proportion of the general population. Their main effect appears to be a dampening of emotional states whereby the magnitude of strong negative and positive emotions is decreased.

Deep Brain Stimulation is reported to have personality-altering effects that may be immediate, large, surprising and dramatic[12]. As far as we know, such effects have been reversible and have disappeared when the DBS equipment is turned off.

In our view, hardly any development within the emerging sciences and technologies causes more ethical concern than that of technology with the potential for personality alteration. What *is a known reality* is that DBS is a proof in principle of the possibility of dramatic non-disruptive personality-altering technologies. It is not known if such alterations also can be irreversible (for instance by the use of a different technological solution). It is also a known reality from World and European history in the 20th Century that authoritarian and totalitarian governments have spared no effort in changing the belief structures, desires and personalities of their population. Personality-altering technologies are attractive from the point of view of non-democratic powers. The case made by Huxley in *Brave*

[11] See e.g. John D. E. Gabrieli et al (2015), *Prediction as a Humanitarian and Pragmatic Contribution from Human Cognitive Neuroscience,* Neuron 85:11-26.

[12] See e.g. M. Schermer (2011), *Ethical Issues in Deep Brain Stimulation,* Frontiers in Integrative Neuroscience,5(17):1-5.

New World is that totalitarian power and the pervasiveness of such technologies may reinforce each other synergistically. They may combine into an attractor in sociotechnical phase space, to borrow a term from complex systems theory.

Furthermore, we know from the history of science that *wired technologies* of electromagnetic currents, contrary to belief, could be recreated as *wireless technologies* of electromagnetic radiation, both for purposes of communication and energy transfer. The scenario of a wireless, radiation-based equivalent to DBS was pursued in the fictional TV series *Dollhouse*. Such and similar scenarios appear to the authors of this report as extremely dangerous to democracy and human rights, and a lot more dangerous than the possibility of human cloning, to the degree that the persistence of democratic civilisation in itself is at risk. How to monitor and regulate research and innovation in this field is a complicated issue. Research may be justified with recourse to suffering (as with DBS) and crime and threat to society (as with chemical castration). What is known, however, particularly in the history of psychoactive drugs, is that a function creep may easily occur by which more and more applications are considered legitimate. Furthermore, illegality simply does not and cannot render unjustified use impossible.

Wirelessness is an interesting case of an ethically specific feature of technology, and we would like to end this subchapter with a short analysis of why this is so. One may argue that a wireless technology such as transcranial magnetic stimulation is a preferable option to deep brain stimulation because the latter requires invasive and essentially risky surgery. We agree that this is a medically relevant and therefore ethically relevant argument. The ethically specific feature of wirelessness that is explored in the piece of fiction mentioned above (*Dollhouse*), however, is that some wireless technologies can work at a distance (and that the radius of action may increase with the improvement of the technology). Non-invasive technologies that work at a distance have the property that they can be difficult to detect. The technology user may stay undetected, unidentified and unaccountable. Another property of wireless communication technologies is that they may more easily emit a one-to-many signal and not only a one-to-one signal. Therefore the stakes may be higher. This is an example of the type of analysis we recommend: an exploration of ethically relevant features.

Nanotechnology as a Paradigmatic Case for Challenges of Uncertainty and Complexity

> *What would the properties of materials be if we could really arrange the atoms the way we want them? They would be very interesting to investigate theoretically. I can't see exactly what would happen, but I can hardly doubt that when we have some* control *of the arrangement of things on a small scale we will get an enormously greater range of possible properties that substances can have, and of different things that we can do.*[13]

Nanoscience and nanotechnology are broad terms that refer to a number of experimental techniques and systems as well as bodies of scientific knowledge. A large part of nanoscientific and nanotechnological research is devoted to basic physical properties of elements and chemical compounds, often in novel or unusual forms, such as fullerenes ("carbon balls") or nano-powdered metals. Another large part of nanotechnology consists of research and development of new physical materials for industry (cars, paints, housing et cetera). Finally, nanotechnology is also an element together with medical science, life science and neuroscience in efforts that may be described as NBIC convergence. The ethical issues of the various parts of nanotechnology are rather different; those closer to the converging technologies are similar to the ethical issues of biotechnology and neuroscience.

Still, there is one general ethical issue that we wish to highlight and explicate by using nanotechnology as the paradigmatic example, namely that of strict uncertainty and complexity. While the relatively recent academic field of "nanoethics" discusses a variety of issues[14], we believe it fair to say that the issue of uncertainty and complexity is the predominant and more important one, a view that is also corroborated by a recent CoE report[15].

Our definition of strict uncertainty, or simply *uncertainty*, will be that of economist Frank Knight (later adapted to technological and environmental governance by Brian Wynne[16]), in which uncertainty is contrasted with *risk.* One is encountering a situation of *risk* if the outcome of a particular event or decision cannot be fully predicted but still well characterised by a set of possible outcomes ("event space"), the probability of which can be meaningfully and reliably quantified.

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[13] Richard P. Feynman 1959, *Plenty of Room at the Bottom*. Talk to the American Physical Society, to be found at http://www.pa.msu.edu/~yang/RFeynman_plentySpace.pdf.

[14] See e.g. Kamilla Kjølberg & Fern Wickson (2007), *Social and Ethical Interactions with Nano: Mapping the early literature*, NanoEthics 1: 89-104, as well as the same authors (2010), *Nano meets Macro: Social Perspectives on Nanoscale Sciences and Technologies,* Pan Stanford Publishing: Singapore.

[15] Report on "Nanotechnology: balancing benefits and risks to public health and the environment", Doc. 13117, report of the Committee on Social Affairs, Health and Sustainable Development of the Parliamentary Assembly of the Council of Europe, rapporteur: Mr Sudarenkov.

[16] Brian Wynne (1992), *Uncertainty and environmental learning – reconceiving science in the preventive paradigm*, Global Environmental Change 1992; 2: 111 – 27.

Under *strict uncertainty,* the probabilities cannot be meaningfully and reliably quantified. A particular form of uncertainty is *ignorance,* in which also the set of possible outcomes is only partially known. Famous cases of ignorance are the surprising medical and environmental side-effects of asbestos, DDT and thalidomide. Uncertainty and complexity are related, because the behaviour of a chemical compound or a technology may be well characterised and understood under controlled and simple conditions in the laboratory, and still behave in new and surprising ways under complex and less controllable conditions in the human body or the natural environment. Under conditions of uncertainty and complexity, there is no way to know in advance whether ordinary procedures of risk assessment and risk management will be able to detect and manage the harms and hazards. Worse, there is no way of ensuring in advance that a real-life situation is not one of uncertainty, ignorance and complexity. This is why risk assessment/management is fallible.

There are two reasons why uncertainty and complexity are particularly important with regard to nanotechnologies. The first relates to the nature of nano structures, and the other to the sociotechnical imaginaries of nanotechnology.

Nano, literally meaning "dwarf", is a metric prefix that signifies one billionth (10^{-9}), in particular nanometre (nm), or 10^{-9} m. In principle, a nanostructure could be any atomic or molecular structure in the size range of less than 100nm, or 300nm (definitions vary). By such a definition, most chemical structures already known, say, water, sugar and the air we breathe, would qualify as nanostructures. Normally, however, that is not how the term "nano" is used. Rather, the objects of nanotechnological enquiry are novel molecular and atomic structures, such as fullerenes and nano silver. The interest in them lies in their *remarkable physical and chemical properties.* They may be a lot more chemically active than their better known relatives, typically due to quantum effects and a higher surface/mass ratio. Furthermore, the chemical activities may be different and *surprising*. This is the whole reason for the excitement that surrounds nanotechnology. Accordingly, one should expect that the release of such compounds and materials into society and the environment is a situation of uncertainty and complexity, in which ordinary procedures of risk assessment and risk management may fail. This problem has been intensely debated both in scientific and regulatory discourse the latter 10 years, in particular in Europe and North America. Indeed, in the European Union the problem has even been subject of political contestations between the Commission and the Parliament. Part of the contestation has been the need for separate regulatory instruments to manage the safety aspects of nanomaterials, and notably if one can depend on ordinary risk assessment or if precautionary principles and measures should be applied. For the same reason, there have been cases in which nanotechnology has been rendered not insurable by insurance companies due to the suspicion of strict uncertainty and ignorance.

In sum, there are specific scientific reasons to expect surprising side-effects of nanostructures that cannot be predicted and controlled in advance. It remains to see the extent to which they can be detected and assessed *ex post* and controlled *post factum,* or if we will encounter new "late lessons" or instances of the Collingridge dilemma – similar to asbestos, DDT and thalidomide.

The uncertainty and complexity arising from nanotechnology, however, is paired with our second reason for concern, which is the scientific belief in *control* as part of the dominant sociotechnical imaginaries of nanotechnology. This belief is already present in Feynman's famous lecture from 1959,

a lecture that has played an emblematic role in the development of research policies and research funding in this field. Feynman's words:

> *[…] when we have some* control *of the arrangement of things on a small scale we will get an enormously greater range of possible properties that substances can have, and of different things that we can do […]*

- indeed show no hesitation or awareness of the possibility that control may not be had. In this type of scientific imaginary, the property of substances is a calculable result of physics and chemistry. There is no awareness of the difference between theoretical results and measurable and calculable properties under controlled and simple conditions in the laboratory, and properties and behaviours that arise as a result of complex interactions in the environment and the human life-world ("things that we can do"). This belief was made even more explicit in another lecture by Feynman:

> *Finally, we make some remarks on why linear systems are so important. The answer is simple: because we can solve them! So most of the time we solve linear problems. Second (and most important), it turns out that the fundamental laws of physics are often linear. [...] That is why we spend so much time on linear equations: because if we understand linear equations, we are ready, in principle, to understand a lot of things.*[17]

The real world, however, is full of nonlinear interactions. Nonlinear interactions are patterns of behaviour where there occur effect outcomes, which are not consistently proportional to cause inputs. For instance, the continuous addition of nutrients to a lake may cause the lake to switch to a new equilibrium of eutrophication, while the precise jump to the new state is discontinuous to the amount of nutrients added. Thus, nonlinearity in nature typically implies a certain complexity (interaction with surrounding systems) and, in many cases, the impossibility of precise control and prediction.

The result of this situation – a combination of the nanotechnological production of new sources of uncertainty and complexity and the scientific belief in control – is a particular cognitive dissonance in the sociotechnical imaginaries. This was never shown better than at one of the first nanotechnology foresight conferences in 1995, in which the well-known scientist Marvin Minsky at first presented a discourse of scientific trans-humanist Utopia[18]:

> *[…] I find it appalling how many people are willing to accept the bad deal they have been given. We ought to be more insistent about improving our brains and our bodies […] I find it even more annoying that we have to live only a hundred years just because of a few evolutionary mistakes.. When we design new forms for ourselves, we will describe our intentions along with the plans.*

He was asked after the lecture by a member of the audience if he anticipated the development of a hacker culture of nanotechnology. According to the conference proceedings, he replied as follows:

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[17] Richard P. Feynman (1963), *The Feynman Lectures on Physics,* Volume 1, Chapter 25, p. 4-5.

[18] Markus Krummenacker & James Lewis (1995): Prospects in nanotechnology: toward molecular manufacturing, Wiley, p. 195ff.

> *There are hackers, and there are crackers. […] It seems to me that a way must be found to keep things open enough so that we can catch malicious people before they can do anything too bad. Accomplishing that will not be easy. We might have to give up our privacy. There are terrible things in the universe. Quasars, for example, appear to be galaxies that exploded because something bad happened there. I wonder how many of those were science-fair projects that got out of hand.*

On one hand full control of Nature is within reach, on the other we may blow up the galaxy. A similar trope is found in the early writings of Eric Drexler, one of the main proponents for the US national nanotechnology initiative, who on one hand predicted the solution and elimination of all environmental problems with the aid of nanotechnology, and in the same book actually was the one who invented the "Grey Goo" scenario later embraced by popular culture: That the accidental creation of self-replicating nano machines might destroy the biosphere of the planet and convert it into a "grey goo".

Such untempered cognitive dissonance in the public domain is becoming rarer. The underlying tension, however, remains between a scientific community – a thought collective in Ludwig Fleck's terms[19] – that actively creates and introduces uncertainty into the world but by its own thought-style is less prone to understand it. Still, because of the level of technicality required in the assessment and management of safety, harm and hazard, it is unavoidable that experts are recruited from the same (and similar) thought collectives. The logical response in modern societies to this kind of tension is to contravene it by introducing other types of expertise within and above the appropriate levels of institutional decision-making. For example, environmental, ethical and legal expertise may be introduced into institutions that monitor scientific and technological developments with a particular emphasis on early warnings of uncertainty and complexity. Perhaps one may claim that the European Environmental Agency is an example of a counterweight institution. If so, its function in this respect is more an outcome of historical events than a political and legal framework. The Council of Science, ICSU, played a role in devising a regulatory framework for the exchange of dangerous chemical substances, starting as discussions within the scientific community and then moving into international (and national) law. The basic challenge consists in designing governance structures that are both adequate to the complexity of its subject matter and effective in realizing goals as safety and security. The Council of Europe may play a role in the development of political and institutional thinking in this regard, devising a framework for such institutions that could improve the safety of citizens, societies and the environment.

[19] Ludwig Fleck (1935/1979), *The Genesis and Development of a Scientific Fact,* (edited by T.J. Trenn and R.K. Merton, foreword by Thomas Kuhn) Chicago: University of Chicago Press.

ICTs as a Paradigmatic Case for Challenges to Human Autonomy and Privacy

If you want to keep a secret, you must also hide it from yourself[20].

There is no need for this report to rehearse the well-developed debates of the ethical issue of privacy and data protection as such. The right to privacy and private life is established since long as a fundamental human right, and the right to not be exposed to unlawful and unethical surveillance by authorities and private enterprises is intensely debated (if not so easy to enforce) in many countries.

In this report about ethically relevant aspects of emerging sciences and technologies, however, we consider three observations to be pertinent. The first relates to the convergence of data gathering into so-called Big Data. The second observation relates to the data gathering and storing actors. The third and final observation pertains to the effect of Big Data on the human condition and the penetration of the life-world by surveillance technologies.

Convergence into Big Data

Current legislation and regulation of privacy and data protection (PDP) typically applies to individual technologies, applications, registries and actors. Health records are subject to one PDP management regime; payment cards to another; social media to a third.

With the increasing interconnectedness and compatibility of devices for data acquisition, storage and transfer, however, the possibility for comprehensive sets of personal data, covering ever more aspects of personal life, has become sociotechnical reality. Already an average person in a modern society will leave thousands of digital traces in the course one day. Let us mention some of them: spatiotemporal coordinates via the smartphone; communication data by the phone and the personal computer, including the content of all messages; payment information (what, where, how much) from using credit or debit cards; use of public transportation (where, when) if using a smart transport card; detailed use of household appliances if the household is equipped with a smart meter (which in principle may provide information down to the choice of TV channel, although this is usually illegal); recordings by security cameras in public places; and more. As described in the Rathenau report, this reality may be expanded in the future by increasing amounts of biophysical/health information, either monitored by personal health devices or also by smart clothes and other instances of the Internet of Things. Radically much more information can be obtained with a biological sample that can be analysed for DNA structure and protein levels. Furthermore, devices for remote surveillance are becoming more sophisticated. For example, the Norwegian company Squarehead Technology "provides advanced microphone array systems for audio capture and acoustical zoom", according to their home page[21]. In effect this indicates a sociotechnical future in which one may remotely listen to

[20] From George Orwell, *1984*.

[21] See http://www.sqhead.com/

and record the individual conversations in a crowd. We recommend that more attention is given to the comprehensiveness of this reality, a reality that is more than just the sum of its parts and that is no longer adequately governed by attending to each individual application.

Who is Watching?

In Orwell's novel *1984,* the agent of surveillance is "Big Brother", the personified embodiment of a totalitarian government. Indeed, a lesson from the 20th Century is that the authoritarian and totalitarian regimes depend upon surveillance technologies and interact synergistically with them and persuasive and personality-altering technologies, as discussed above. The more Big Brother knows, the easier it is for Him to persuade, change and control his citizens. The availability of extremely sophisticated surveillance technology and highly connected infrastructures for data acquisition and exchange are accordingly in themselves a risk to democracy, because the combination of such technologies and infrastructures with states that wish to employ them on their citizens is an attractor point in sociotechnical phase space. The many public scandals the latter years also indicate the development of a type of political regimes that in many respects are constitutive liberal democracies but still develop comprehensive policies of mass data collection upon their own citizens as well as abroad. Clearly, international governance initiatives have not been able so far to come to terms with this situation.

However, what is new in the present situation is the emergence of large private enterprises that has mass data collection as the central element of their business model. Facebook and Google are two prominent examples that also consciously try to expand the suite of data to be collected – to the extent that Facebook expressed the desire to record at wish sounds from individual users' surroundings – exactly because a comprehensive data set is of much higher information value than a simpler one. The respect for autonomy and the right to privacy are in principle threatened by enterprises with this type of business model, and we cannot see that citizens, civil societies or public authorities have been able so far to decelerate the expansiveness of their mass data collection practices. The magnitude of this challenge seems to call for coordinated international action.

Finally, it should not be forgotten that the availability of ICTs and social media implies that the average citizen in a modern society also easily may engage in activities that infringe upon others' right to privacy and confidentiality. Many of these activities will in principle be illegal, such as obtaining a biological sample – for instance a few hairs or some saliva – and analyse its DNA, or reading others' messages on a computer or phone. Still, they are so easy to perform that regulatory frameworks should be made on the assumption that they will be frequently performed. Some of them will also be legal, for instance "stalking" others for information on social media and the internet. Already by skilful analysis of publicly available information, the right to privacy and confidentiality may be threatened.

The Panopticon, Governmentality and the Right to Private Life

We wish to warn against one argument often heard in the ethical and political debates around privacy and data protection. The argument is that the habits of many social media users show that they do not care about privacy and confidentiality, and accordingly the right to privacy is obsolete and irrelevant.

For one, this type of argument paves the way for large governmental and corporate actors whose intentions with mass data collection are not immediately clear and transparent to citizens. Exhibitionism is no consent to surveillance and abuse.

Secondly, the skill and precision with which for instance young people choose what to share and what not to share on the internet should not be underestimated. To carefully build a persona on social media can actually be seen as a way to enact one's right to privacy.

Thirdly, and most importantly, the argument that the right to privacy is obsolete ignores the qualitative difference represented by the convergence of Big Data and comprehensive data collection. What is at stake is not only the risk of abuse but something more: The possibility of having an everyday life without being visible all the time. The literary reference to this situation is the *Panopticon,* which in Bentham's original idea was a design for a prison. As argued by Michel Foucault, the development of modern states in the 19th and 20th Century that were ever more concerned with the detailed lives (and capacities) of its citizens, led to a change in how power was exercised. The states became less dependent on the use of direct violence to govern its citizens. Instead, the citizens, knowing that the state is concerned and potentially may or may not observe, develop an inner discipline that exercises the desires of the government by itself. Foucault called this phenomenon *governmentality*.

It is important to note that governmentality is a feature of modern states in general, including constitutive liberal democracies. Furthermore, state biopolitics was complemented during the 20th Century into an ever more powerful consumer market that, with the aid of marketing science, constructed many new needs and desires. In wealthy countries many surprising health problems can be noticed: eating disorders, pervasive dissatisfaction with own body appearance, in particular among women, pathological lack of self-esteem and purpose. The *Panopticon* provided by ICTs is likely to aggravate this situation.

More generally, it has been argued by psychologists such as Emilio Mordini that the right to privacy and the possibility to perform everyday undertakings without being seen, monitored or noticed, may be fundamental to the development of a sane personality. Indeed, in a volume edited by Mordini and Paul de Hert, the latter and Eugenio Mantovani discuss an Italian court case in which the court ruled in favour of the plaintiff, a physically disabled person who complained on the lack of adequate physical facilities that could enable him to perform vital outdoor activities:

> *[…] the Court held that the notion of "private life" had to be expanded to "ensure the development, without outside interference, of the personality of each individual".* [22]

Current developments of convergence into comprehensive Big Data performed by public and corporate actors as well as by the public itself, is in many ways a large-scale social experiment. Never before have so many data about so many individuals been stored in so many places. There is considerable uncertainty about how this development may affect the right to privacy as a basic element in the human condition for personality development. This uncertainty is in itself a significant concern.

Medical and Non-Medical Domains and Applications

We shall now turn to three aspects that will be given less space in this report but which in no way are unimportant or irrelevant for the debate on ethical issues of emerging sciences and technologies. The first of these aspects concerns the distinction between the medical and the non-medical domain as an ethically relevant distinction. We have two comments in this regard.

First, we underline the importance of the one of the main conclusions of the Rathenau report *From Bio to NBIC Convergence,* namely that types of technological applications that previously were found almost exclusively in the medical domain, are moving out into other domains, of home care, sports, recreation, leisure and work life. While this undoubtedly will create health and other benefits for many individuals, it will also create new risks and threats, not the least to privacy. The Rathenau report provides a series of examples of such applications. The implication for ethics is quite straight-forward: More ethical attention to biotechnologies and related technologies has to be given to domains outside medical research and practice and the health sector. In order to do *bioethics* it will no longer suffice to focus on medical domains. A broadening of the scope of work of institutions such as the DH-BIO is accordingly well justified.

At the same time, however, one can also note a longer trend of an *expansion* of the medical domain and a *blurring* of the line between medical and non-medical. This line has always been subject to scientific, cultural and political change; one may be reminded of the history of psychiatry. What seems to be clear, however, is that long-term processes of *medicalization* can be observed, whereby standards for physiological and functional normality are heightened and narrowed, and deviations from the normal to an increasing degree are regarded as pathological and in need of medical care and intervention. A particular manifestation of this trend is the increased medical attention to risk factors for later (potential) illness and disease. The overall consequences of this trend remain a matter of controversy. While some discussants will emphasize the health benefits resulting from better risk assessment and management, others will emphasize the collateral effects on the individual and collective level. Such effects include individual health anxiety and a societal change towards what has been called the "therapeutic culture", in which problems previously regarded as

[22] Paul de Hert and Eugenio Mantovani (2010) *The EU Legal Framework for the E-Inclusion of Older Persons,* in Emilio Mordini and Paul de Hert (eds), Ageing and Invisibility, IOS Press, Amsterdam, pp 83-120.

social or political become a matter of individual health care. The development and availability of health monitoring technologies for individual consumers is in our opinion likely to strengthen such trends. To what extent they should be subject to international ethics regulation, is not clear to us; what is clear, however, is that they exemplify the complexity and ambiguity of overall health effects of health-related innovations. “More” is not always “better”; it can actually be worse[23].

[23] In addition to the «classical» readings on the problem of medicalisation, in particular by Ivan Illich, see e.g. Elliott S. Fisher and H. Gilbert Welch (1999), *Avoiding the unintended consequences of growth in medical care – how might more be worse?* Journal of the American Medical Association, 281:446-453.

Global Divides and Equitable Access

Our second comment related to one of the most discussed issues in nanoethics and ICT ethics, that of the nano-divides and the digital divides.

A technological "divide" is a term that is short-hand for the unequal distribution and access to technology, materially and in terms of knowledge required to use it. The divides are present both intra- and internationally. Within countries there are such divides to be found between social strata. It is also a well-established fact that there are large inequalities in this respect between countries and systematically between different regions of the world. As one might expect, the global divides correlate to a large degree with differences in wealth and human development and reinforce these differences.

Differences in the wealth of nations are ethically and politically important. They are relevant for the work of institutions such as the DH-BIO because equality, justice and equity are matters of ethical concern. Indeed, differences in wealth may directly affect fundamental human rights and freedoms. For instance, access to and security of food and energy supply may be affected and threatened by the introduction of new technologies. This may happen when basic infrastructures of a society are changed by technology uptake in ways that exclude individuals, social strata or populations without technological access or skill. For instance, the controversies around genetically modified crops in India and Latin-America were not primarily about food and environmental safety (as in Europe) but about food security in a context of increased dependency of expensive agrobiotechnology. In a similar vein we may observe how ever more services of European welfare states depend on the citizens' access to and knowledge of personal computers and the internet. The development and implementation of emerging sciences and technologies should be monitored for the risk of exclusion from vital infrastructures.

Converging Technologies for Military Use

Finally, although this is not our main field of expertise, we would like to make the observation that ethical issues related to military use are underrepresented in ethics guidelines and activities. It is obvious, however, that many of the issues that arise with persuasive and personality-altering technologies, enhancement, mass surveillance, non-traceability of nano-sized bioactive agents, markers and measuring devices, autonomous robotic systems et cetera become particularly acute in contexts of military use and warfare. While some applications are not yet reality, use of semi-automated drones and enhancement drugs in warfare is a documented fact. The DH-BIO is also

advised to visit e.g. the website of MIT's Institute for Soldier Nanotechnologies[24] for real-life, if not plainly shocking, examples of currently ongoing military research in this area.

There is comprehensive international governance of nuclear weapons and biological and chemical weapons. We do not have an overview of the equivalent institutions for warfare with robotics, nanotechnology, neurotechnology and converging technologies; we fear that they are not well developed. We believe the Council of Europe is well positioned to obtain a global perspective on the situation and consider measures to be taken.

[24] http://isnweb.mit.edu

3. Implications for the Protection of Human Dignity and Identity, the Right to Integrity, and Other Human Rights and Fundamental Freedoms

We shall now briefly review what we believe to be the priority challenges to fundamental human rights and freedoms in the ethical issues presented in the previous chapter.

Convention on Human Rights and Biomedicine

The scope of the Oviedo Convention is the application of biology and medicine. As we have seen above, today, almost 20 years after the convention was made, also other sciences and technologies pose ethical challenges to human rights and dignity of the human being. In what follow, we will accordingly not distinguish whether a certain technological application can be said to fall within biology and medicine or not.

With that in mind, we observe that several of the rights protected by the Oviedo Convention are at stake in the emerging sciences and technologies:

Article 1: Dignity, identity and integrity of all human beings. Our review of neuroscience as a paradigmatic case included a number of threats to dignity, identity and integrity.

Identity is threatened individually and collectively by persuasive and personality-altering technologies, and collectively by enhancement technologies that could lead to human speciation events or even the emergence of new life-forms that couple machines, bodies and consciousness. Identity is also under threat if comprehensive surveillance if conditions for personality development are hampered by the undermining of the possibility of having a private life and exercising the right to privacy.

Integrity may be threatened by direct and indirect pressure and coercion to subject oneself to enhancement technologies, whereas mental integrity is at stake as collateral effects of personality-altering technologies.

Dignity is always difficult to define; however, we believe that all of the examples in this paragraph also constitute a threat to human dignity. In particular, enforced or unnoticeable persuasion or personality alteration must be seen as violating human dignity.

Our claim that human identity is threatened is a very radical claim; the burden of proof may be high for those who hold it. Still, as we have explained above, in the governance of emerging sciences and technologies one has no choice but also base one's decisions on imaginaries and trends and not only material realities. Otherwise action will inevitably come too late. This is why principles such as the precautionary principle, Responsible Research and Innovation (in the EU), and anticipatory governance (in the USA) have been proposed. We would also like to refer to the insights provided by the philosopher Hannah Arendt on the surprising malleability of the human condition: Whereas the revolutionary authors of the French and American constitutions imagined a set of inalienable and

eternal human rights, grounded in *lex naturalis,* the 20th Century proved that human rights cannot only be violated, but the human condition may be so utterly changed as to render them unenforceable, unthinkable and eventually absent. What did human identity and dignity mean for concentration camp survivors who no longer could remember their own name and personal history? At this point the contrast of *Brave New World* to *1984* is useful. Whereas Orwell's *1984* mainly thematise violent oppression, *Brave New World* creates the scenario of a world in which violent oppression no longer is needed because human desires for rights and freedoms have changed. Identity, dignity and integrity as we know it, have ceased to exist. We believe that the type of scenario presented by *Brave New World* is neither unthinkable nor necessarily unlikely anymore.

Article 2: Primacy of the human being. This principle is clearly at stake today when governmental and corporate interests perform research and innovation to develop new technological opportunities for mass data collection and persuasion. It is also at stake in experimental research on human subjects for which there is inevitable uncertainty about collateral effects, in particular when performing interventions on the human brain, which is known to be a richly coupled neural network and *a priori* can be expected to experience side effects.

Article 3: Equitable access to health care. This principle is at stake in global divides such as the digital divide and the nano-divide insofar as technological developments create or change infrastructures that exclude those who do not possess access or knowledge to use the technology. We have mentioned examples above.

Article 10: Private life. In the Oviedo Convention this principle is invoked with respect to health information. What can be learnt from the emergence of mass data collection, Big Data and the blurring of the line between the medical and the non-medical, is that more than just health information as conventionally understood can be critical for the possibility to exercise and uphold a private life. Indeed, already a payment card or a smart power meter, if unregulated, can undermine this right.

Convention for the Protection of Human Rights and Fundamental Freedoms

We have also found it useful to return not only to the Oviedo Convention but also to the European Convention on Human Rights itself. As we will briefly show below, this is useful to identify the full scope of the ethical issues at stake in emerging sciences and technologies. We shall accordingly briefly comment on the relevance of two articles that present a larger range or scope of human rights and freedoms than immediately visible in the Oviedo Convention.

Article 8: Right to respect for private and family life. Our only comment here is to observe that this right is not limited to the scope of biology and medicine but applies generally. Specifically, there may be an exception for the *necessity* of the economic well-being of the *country,* which is no carte blanche to mass data collection as a business model for multinational corporate interests. Indeed, not even in issues of national or societal security is there any carte blanche to data collection. This

has been confirmed by the European Court of Human Rights, perhaps most notably in the case of S. and Marper against the UK[25]. In this case, the Court indeed ruled that the United Kingdom had violated the right to respect for private life by keeping biological samples that had been collected during criminal investigation of two citizens who were later acquitted. The Court stated:

> *[…] The Court noted that cellular samples contained much sensitive information about an individual, including information about his or her health. In addition, samples contained a unique genetic code of great relevance to both the individual concerned and his or her relatives. Given the nature and the amount of personal information contained in cellular samples, their retention per se had to be regarded as interfering with the right to respect for the private lives of the individuals concerned.*
>
> *In the Court's view, the capacity of DNA profiles to provide a means of identifying genetic relationships between individuals was in itself sufficient to conclude that their retention interfered with the right to the private life of those individuals. The possibility created by DNA profiles for drawing inferences about ethnic origin made their retention all the more sensitive and susceptible of affecting the right to private life.*
>
> *The Court concluded that the retention of both cellular samples and DNA profiles amounted to an interference with the applicants' right to respect for their private lives, within the meaning of Article 8 § 1 of the Convention.*

In our view, the current collection of comprehensive and linked "big" data sets via social media, the internet of things and other devices may constitute a threat to the right to respect for private life of similar magnitude.

Also, we will mention *Article 9: Freedom of thought, conscience and religion.* Often, the article is invoked when the right to *manifestations* of these freedoms is violated. However, as we have explained above, the right to freedom of thought and conscience itself, that is, freedom from interference and intervention on cognition and brain processes, is at stake in the development of persuasive and personality-altering technologies. We will also repeat that this is not only a question of fictions and imaginaries but stark reality, as evidenced by already existing national prohibitions of subliminal advertising; Facebook's emotion contagion study; and invasive neurotechnologies such as Deep Brain Stimulation.

In the last chapter, we shall present our suggestions for measures to be taken to defend and protect these human rights and freedoms from the threats and challenged posed by emerging sciences and technologies.

[25] The European Court of Human Rights (2008). Case of S. and Marper v. the United Kingdom. http://hudoc.echr.coe.int/sites/eng/pages/search.aspx?i=001-90051

4. Recommendations

Finally, in this report we briefly indicate the lines along which we would like to propose our recommendations for the DH-BIO. Such recommendations should be a matter of dialogue and we look forward to receiving the committee's opinions and comments on these indications. The recommendations are ranked in priority, Recommendation 1 being the one that we regard as the overarching one, and then the following recommendations each attending concerns that are urgent and important, though in descending order.

Recommendation 1. This report has identified a number of developments within emerging sciences and technologies that pose serious ethical issues and concerns, on the individual, collective and even international level. The Council of Europe has an important role in being a forum for continuous reflection and discussion needed to root the answers to the new ethical issues in shared European values and shared criteria for action. The Council of Europe is uniquely placed to take a leading role in this work, being not only a champion of human fundamental rights and values in the European tradition but also by its wide geographical coverage. The scope of the bioethical work of the Council should be **permanently expanded** to cover the developments in **nano-, neuro-, info- and cogno-science and technology**.

As explained above as well in the Rathenau report, an important characteristic of the current scientific and technological development is the increased interaction and convergence of the various fields. We do not consider it useful to e.g. establish separate ethics committees for, say, biomedicine on one hand and nanotechnology or cognitive science on the other. Rather, it seems a better solution to expand the scope and strengthen the resources of the existing work on bioethics. One option would be to expand the mandate of the existing committee on bioethics to a committee on the **ethics of science and technology** (in a similar vein to the COMEST committee of UNESCO). Furthermore, as explained above, the distinction between the medical and the non-medical is becoming less clear and less relevant in many issues. We accordingly recommend that the scope of ethical work is expanded beyond a medical/non-medical boundary. This does not imply that there no longer is a need for specific guidelines or principles within the medical domain. They are necessary; but they are not sufficient. In order to cover the needs for ethical work outside the domain of medical research and practice, however, both novelty and creativity in institutional practices are being called for.

Recommendation 2. Better governance is needed to increase the ethical and social robustness of new and emerging sciences and technologies. Such robustness can only be achieved if those affected by the scientific and technological developments are included in the processes of governance. However, all of society are affected because of the pervasiveness of modern science and technology. In line with the European heritage of democracy, a significant task for bioethical work is to accordingly play a **proactive part in the democratization** of the governance of science and technology and thereby our common scientific and technological future. This includes to develop and

encourage participatory foresight exercises, upstream engagement and other practices of what has been called "responsible research and innovation" (RRI). As has been repeatedly noted by the EU and also the academic literature on the subject, improved governance should not be seen as opposed to progress and the right to freedom of research. On the contrary, lack of communication and mutual trust between science and society will ultimately lead to a breakdown of public support in research and innovation that few will see as conducive to progress and that may imply a much greater threat to the freedom of research and the autonomy of scientific institutions.

The DH-BIO is already to some degree taking part in the production of sociotechnical imaginaries role through its activities. The work should be strengthened. The Council of Europe may and should perform its own activities for exploratory and exemplary purposes. Another important role, however, is that of encouraging states to take their national and international responsibility for a democratic and responsible governance of science and technology in this regard. The Council could contribute also by shaping criteria, collecting best practices and providing advice and recommendations for states. We believe there can be strong synergies between such initiatives from the Council of Europe and similar efforts in the European Union and its so-called Associated States taking part in the European Research Area. The Council may strengthen, intensify and enrich this work by seeking active collaboration also in ongoing activities within the EU and the ERA, for instance connected to RRI and EU's Science-with-and-for-Society programme. The Council may also wish to employ the recent Rome Declaration on RRI[26] as a point of departure, together with the valuable ideas on public participation transmitted in UNECE's Aarhus Convention[27]. A main added value provided by the Council is its focus (and expertise) on human rights as well as its geographical scope. Resources should be made available to facilitate such work.

Recommendation 3. In our report, we have observed **threats to several fundamental rights and freedoms** laid down by the Oviedo Convention as well as the Convention for the Protection of Human Rights and Fundamental Freedoms. A number of possible ways forward can be imagined also in terms of legal approaches and instruments, including new Recommendations on specific technological fields. For instance, one could consider to recommend mandatory ethics review of research fields that involve important ethical issues that fall beyond or outside of biomedicine and bioethics.

We would like to propose, however, that the Council of Europe also considers the possibility of establishing a new convention for ethics of science and technology in general, beyond the bioethical domain in a strict sense and with a wider scope of ethical issues. We have indicated the main fundamental rights and freedoms that we believe to be at stake in chapter 3. They include **identity, integrity and dignity, right to private life** and **freedom of thought**. It will be an important task to see how they can be secured as new and emerging technologies rapidly are created and introduced into society and human life. However, we have also argued that the new and emerging technologies in addition to their obvious benefits also raise concerns over **safety, equitable access and justice**. We

[26] See http://ec.europa.eu/research/swafs/pdf/rome_declaration_RRI_final_21_November.pdf
[27] See http://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf

have observed that the UNESCO Declaration on Bioethics of 2005 includes aspects such as those of equality, justice and equity; solidarity and cooperation; social responsibility and health; benefit sharing; and the protection of future generations and our natural environment. We would propose that such aspects are considered in a future convention for ethics of science and technology.

Recommendation 4. It is important to discuss **how measures can be taken** when the normative basis and the legal instruments are present, but new practices in the world of science and technology are seen to systematically violate them. For instance, the report has raised the question if not the new phenomenon of mass data collection and surveillance as a business model indeed is a **violation of fundamental rights and freedoms** of citizens. Still, there seems to be no political, legal or other governmental institution present in our societies that has the mandate or power to take firm measures on this basis. Simple measures of prohibition would clearly not work; they would typically infringe a number of other legal rights in democratic societies with (relatively) free markets. We think it is important to recognize the complexity of this challenge and the need new instruments and institutions of governance as well as institutional change. The Council of Europe could play an important role in this truly supranational challenge of institutional innovation, for instance by employing its experience and expertise to explore the possibilities for improved judicial defence of human rights in this area.

Recommendation 5. Several technological fields call for continuous **monitoring** with respect to the ethical issues they pose. This includes **human enhancement, persuasive and personality-altering** technologies and other technologies that interfere with the preconditions for enjoying **fundamental rights and freedoms**. The Council of Europe is encouraged to take a proactive role in the development and harmonization of such ethical monitoring schemes and practices.

There is no unique definition of "monitoring". The importance of this challenge in part lies in the fact that it is so difficult. There are unresolved conceptual and epistemological challenges in how to identify early ethical warnings about research and innovation pathways. The state of academic knowledge with respect to these challenges has advanced the latter years but there is no general, simple, ready-made solution to implement and it seems unlikely that there will be such a solution. Still, the Council of Europe would do well in its further efforts to consult the work by the European Environmental Agency on "Late Lessons from Early Warnings"[28] as well as the academically grounded policy literature on anticipatory governance of emerging technologies[29]. Examples of novel ethical monitoring methodologies have been provided by various EU-funded research projects, based respectively on mapping of public values; of public "hot topics" and sociotechnical imaginaries; and

[28] Poul Harremoës et al. (2001), *Late lessons from early warnings: the precautionary principle 1896-2000,* Environmental Issue Report No 22, EEA, Copenhagen; David Gee et al. (2013), *Late lessons from early warnings: science, precaution, innovation,* EEA report No 1/2013.

[29] See in particular Alfred Nordmann et al. (2004). *Converging technologies – shaping the future of European societies, report for the EuropeanCommission via an expert group on foresighting the new technology wave,* Brussels: European Commission.

on interdisciplinary technology assessment methods[30]. This methods may complement the more conventional approach of ongoing or periodic assessment of the state of technological development with respect to already defined ethical issues – checking for red flags, as it were.

In sum, a variety of conceptual frameworks exist or are being developed. They may require institutional innovation and change, however, in order to be fully implemented. Some forms of monitoring can be performed by standing or ad hoc ethics committees; others necessitate other institutional arrangements, of the RRI type. An important dimension of the institutional challenge is to ensure sufficient mandate and power of these institutions so that they may take the right measures. An ordinary ethics committee might be "too weak"; a risk regulation may depend on the existence of quantitative and robust risk estimates; legislation based on the precautionary principle may be ruled inferior to principles of proportionality; et cetera. In sum, the challenges may be too big for academic researchers, sectorial public authorities or even individual national governments. This calls for international collaboration and co-production of knowledge, understanding, practices and institutions, and we believe that the Council of Europe and the DH-BIO may play an important role.

[30] For instance, one may consult the following EU FP7 projects that included the authors of this report: Value Isobars, http://valueisobars.eu/; Technolife, http://technolife.no/ ; and EPINET, http://epinet.no .