Neuroscience and nanotechnologies in Japan – Beyond the hope and hype of converging technologies

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SUMMARY

Nanotechnologies are often said to be "converging" with other technologies like biotechnology, information technology, and cognitive science. And so-called "NBIC convergence" is thought to enable "enhancement" of human performance. First, I classify various kinds of enhancement. Second, I focus on the "cybernetic enhancement," to which nanotechnologies are supposed to contribute, and analyze the connection and integration of humans with machines, which could lead to the cyborgization of human beings. Third, I examine the portrayal of robot/cyborg technology in Japanese popular media, point out the tendency to empathy or ensoulment concerning robots/cyborgs, and raise the question of "ethical issues of ethical enhancement." Fourth, I compare nanotechnologies with neurotechnology and criticize the hype of "converging technologies."

Key-words: Nanotechnology, Science, Technology, Japan, Neurosciences, Human enhancement, Medicalization, Transhumanism, Progress, Future of mankind, Social control over science, Social representation.

RÉSUMÉ

LA NEUROSCIENCE ET LES NANOTECHNOLOGIES AU JAPON – AU-DELÀ DE L'ESPOIR ET DU BATTAGE MÉDIATIQUE DES TECHNOLOGIES CONVERGENTES

On dit souvent que les nanotechnologies « convergent » avec d'autres technologies telles que la biotechnologie, l'informatique et les sciences cognitives. Et cette soi-disante « convergence NBIC » est supposée permettre « l'amélioraton » des performances humaines. D'abord, je classe différentes sortes d'amélioration. Dans un deuxième temps, je me concentre sur « l'amélioration cybernétique » à laquelle les nanotechnologies sont censées contribuer, et j'analyse la connexion et l'intégration des humains avec les machines, ce qui pourrait conduire à la cyborguisation des êtres humains. Troisièmement, j'examine la représentation de la technologie robot/cyborg dans les médias populaires japonais, j'indique la tendance à ressentir de l'empathie vis-à-vis des robots/cyborgs et à les doter d'une âme, et je soulève le problème des « questions éthiques de l'amélioration éthique ». Quatrièmement, je compare les nanotechnologies avec la neurotechnologie et je critique l'abattage médiatique des « technologies convergentes ».

Mots-clés : *Nanotechnologie, Science, Technologie, Japon, Neurosciences, Amélioration, Médicalisation, Transhumanisme, Progrès, Devenir de l'humanité, Contrôle social de la science, Représentation sociale.*

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In the report *Converging Technologies for Improving Human Performance*[1], Roco and Bainbridge associated the convergence of technologies including nanotechnologies with the enhancement of human performance. *Enhancement* as a bioethical term means "technological improvement of the performance of a healthy/normal individual." The term is used as the opposite of *treatment* or *therapy*. The role of medicine is traditionally considered to be the treatment of disease and injury, but the rapid developments in biomedical technology have also made it possible to "enhance" already healthy people, i.e. to make them "better than well."

1. CLASSIFICATION OF ENHANCEMENT

Enhancement can be classified from several viewpoints. First, it can be classified according to the object of enhancement: *physical enhancement* and *mental enhancement*. The latter can further be subdivided into *emotional enhancement*, *intellectual enhancement*, *moral* or *ethical enhancement,* etc. Second, it can be classified according to the means of enhancement: *surgical enhancement*, *pharmacological enhancement*, *genetic enhancement*, *cybernetic enhancement*, etc. This classification will be discussed in detail below. Third, it can be classified according to the range of enhancement: enhancement improving the performance of a person from the bottom of healthy or normal range to the average or the top (*compensatory enhancement* or *promotive enhancement*) and enhancement improving performance beyond the usual upper limit of the human species or enhancement adding a new capacity which ordinary human beings lack (*radical enhancement*)[2]. Fourth, it can be classified according the feasibility of improving technologies: already possible enhancement (*existing enhancement*), enhancement which will be possible in the near future (*emerging enhancement*), and futurological enhancement whose technological feasibility is uncertain (*speculative enhancement*). And fifth, enhancement of oneself based on self-determination and enhancement of others (e.g. one's children).

A well-known example of *surgical enhancement* is *cosmetic surgery*, which is already socially accepted in a lot of countries. Some feminists criticize not only cosmetic surgery but also an ordinary effort to be beautiful, claiming that it means to be caught in the trap of "chains of beauty." Others claim that cosmetic surgery can be a means of emancipation in the sense that it is an active self-transformation of the body, provided that it is performed on the basis of individual self-determination. The question is then whether the desire of individuals to intervene in their own physical appearance is actually based on autonomy or rather motivated by dubious aesthetic norms of society which exerts unconscious pressure on its members.

As for *pharmacological enhancement*, one example is the manipulation or control of emotion by psychotropic drugs like Prozac[3]. If anti depressant drugs are used as mood-brighteners[4] or *"happiness drugs"* when the depression concerned is not pathological, they are called *lifestyle drugs*, i.e. drugs not to cure disease but to improve the "quality of life" of users. It is often difficult to distinguish between pathological depression and non-pathological depression. As a result, it is sometimes said that ordinary depression is pathologized and the daily-life world (*Lebenswelt*) is more and more medicalized. Critics of *pathologization* or *medicalization* of everyday life refer to the *authenticity* of emotion or personality. We are usually glad and happy when some delightful events occur. If we are happy by means of drugs without the presence of anything to be delighted with, critics say the happiness is not real but empty. According to them, sadness and sufferings can also have the positive value to lead individuals to the insight into the *conditio humana*, so if you eliminate these undesirable emotions pharmacologically, you will lose the incentive for efforts to improve yourself. Counter-critics call the criticism an unjust *moralization* of the issues in the sense that critics do not allow individuals to palliate their suffering which can be reduced by technological means.

Another example of pharmacological enhancement is *"smart drug"* like Ritalin. In the US, a great number of school children diagnosed with ADHD (attention deficit hyperactivity disorder) are treated with Ritalin

1. Roco, Mihail C. and Bainbridge, William Sims, *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science,* 2002.
2. Bettina Schöne-Seifert et al. (eds.), *Neuro-Enhancement: Ethik vor neuen Herausforderungen*, 2009.
3. Kramer, Peter D., *Listening to Prozac*, 1993.
4. The President's Council on Bioethics (Kass, Leon R. et al.), *Beyond Therapy: Biotechnology and the Pursuit of Happiness*, 2003.

or some other stimulant drugs. These drugs are said to be used "off-label" to improve concentration before or during examinations by high-school and university students.

As for *genetic enhancement*, the problem of so-called *"designer babies"* received much attention. The feasibility of the technology to "design" a child as you like may be slight in the near future, but the possibility to select some traits of an unborn baby is not far in the future or has already been partially realized.

2. CYBERNETIC ENHANCEMENT

Cybernetic enhancement is the enhancement connecting and fusing humans with machines. Nanotechnologies are supposed to contribute to the development of direct connection between nerve cells and electronic devices through miniaturization. *Transcranial magnetic stimulation (TMS)* is non-invasive, so the probability is high that it will be used for enhancement, whereas *deep brain stimulation (DBS)* is invasive in the sense that the pulse generator, extension, and lead need to be surgically implanted. DBS is now used for the treatment of Parkinson's disease, essential tremor, and other *neurological diseases*. In some countries, clinical research in the treatment of *psychiatric diseases* (e.g. major depression and obsessive-compulsive disorder) by DBS is being performed. Some researchers in Japan are attempting to start clinical research, but since the Japanese Society of Psychiatry and Neurology made a resolution denying psychosurgery in 1975, it might be difficult to begin clinical research in Japan at this time. Because of the invasiveness and risk of surgery, the possibility of using DBS for enhancement is slight for the time being, but if the safety and efficacy of DBS advance, this possibility cannot be disregarded: "Patients themselves do not seem to consider it an ethical problem that an artificial stimulating device influences their mind as long as it makes them feel better."[5] DBS could then be used as a tool for mood or behavior (self-)manipulation.

If the connection between human and machine becomes strong and indissoluble, the merged unity is called *cyborg* (cybernetic organism). In this case, human beings are cyborgized or machines are humanized. If the *cyborgization* of humans and the *humanization* of machines progress, the boundary between human and machine could become unclear. As Joachim Schummer points out, *science fiction* authors played an important role to form the public perception of nanotechnologies in the US.[6] Similarly in Japan, *manga* and *anime* are said to have contributed to form the public perception of cyborg and robot technology.

3. PORTRAYAL OF TECHNOLOGY IN JAPANESE POPULAR MEDIA

"Astro Boy" by Osamu Tezuka was extraordinarily popular among both young and adult Japanese. It was first published as manga in the early 1950s, and the TV anime was broadcast in the 1960s. To explain the plot briefly: Dr. Tenma built Astro in the image of his son who had died in a car accident. Dr. Ochanomizu brought him up so gently that Astro developed emotional relationships with human beings and began to fight against evil. Tezuka also established "Robot Laws." Some examples of these laws: "A robot is created to make human beings happy." "A robot is created to serve human beings." "A robot may not injure or kill human beings." "All robots shall be free and have the right to live a free and equal life as long as it does not conflict with the preceding laws." Tezuka said he had made the "Robot Laws" independently of the "Three Laws of Robotics" by Isaac Asimov.

"Cyborg 009" by Shotaro Ishinomori and "Eighth Man" by Kazumasa Hirai and Jiro Kuwata were both published as manga and then broadcast as TV anime in the 1960s. These manga and anime, especially Tezuka's "Astro Boy," are said to have contributed to the *robophilia* in Japan. When *industrial robots* were introduced in factories, there was practically no Ludditism in Japan. FANUC is one of the pioneer companies in this field: robots are producing machines and robots in the factories. *Humanoid robots* are also created for the purpose of exhibition, entertainment, etc. A well-known example is ASIMO by Honda. *Animaloid robots* like AIBO by Sony serve as pets for the purpose of entertainment and mental "healing." A recent example of humanoid robots is HRP-4C by the National Institute of Advanced Industrial Science and

5. Merkel, Reinhard et al., *Intervening in the Brain: Changing Psyche and Society*, 2007, p. 186.
6. Schummer, Joachim, "'Societal and Ethical Implications of Nanotechnology': Meanings, Interest Groups, and Social Dynamics" in: Schummer, Joachim and Baird, Davis (eds.), *Nanotechnology Challenges: Implications for Philosophy, Ethics and Society*, 2006.

Technology, which was demonstrated on March 16, 2009 and appeared as a fashion model at Japan Fashion Week on March 23.

In Japan, people tend to treat robots as if they were alive and had feelings, i.e. people are inclined to empathize with robots. The issue of *empathy* or *ensoulment* concerning robots and cyborgs is one of the main motifs which inspired Shirow Masamune to draw the manga *"Ghost in the Shell."* It first appeared around 1990 and the animated film was produced in 1995. As the title suggests, the manga is motivated by the issue of *ghost in the machine*. It is known that Gilbert Ryle coined the phrase to criticize Cartesian dualism[7] and Arthur Koestler also used it in his book[8]. Koestler utilized it in a slightly different sense: *primitive brain areas* responsible for hate, anger and other impulses, which sometimes overrule reason and could lead to the *self-destruction* of humankind under certain circumstances. If primitive, emotional brain structures could invite self-destruction, does it follow that we should *control our emotions technologically*, e.g. pharmacologically?

Neuroethics is sometimes divided into the *ethics of neuroscience* and the *neuroscience of ethics*[9]. The former includes *research ethics* and *clinical ethics* concerning the neural system, whereas the latter includes *neuroscientific research* on the neural basis concerning ethical cognition and behavior and its *ethical and social implications*. If the neuroscience of ethics advances and is applied technologically, the enhancement of ethical cognition and behavior, that is to say, *ethical enhancement* might be possible. The neuroscience of ethics may seem to be a future dream, but a complete explication of the neural mechanism is not necessary for ethical enhancement to be possible. For example, oxytocin is already used as compassion drug or perfume and can be considered a precursor of *"ethics drugs."* As I described in Section 2, *ethics TMS/DBS*, *ethics chips* (neuroimplants for ethical enhancement), or *ethicosurgery* (new version of psychosurgery for ethical enhancement) might be technologically possible. Is ethical enhancement the first step to the *final solution of ethical issues*, leading us eventually to perpetual peace? Or is it rather the beginning of the *end of ethics*, leading to the *Neuro-Armageddon* like the dreaded Nano-Armageddon[10]?

4. COMPARATIVE CONSIDERATIONS OF NEUROTECHNOLOGY AND NANO-TECHNOLOGIES

As I mentioned in Section 1, enhancement that improves performance beyond the usual upper limit of ordinary humans is called radical enhancement. *Transhumanists* advocate this type of enhancement and wish that someday *posthumans* or *superhumans* will be born or produced. Their belief in the power of scientific knowledge and technology, i.e. their *scientism* could be called quasi-religious. *Neuroscientism* and *nanoscientism* involve quasi-religious belief in the power of neuro- and nanotechnologies.

According to Eric Racine, bioethicist at the Montreal Clinical Research Institute, "we are like moths, lured by the flickering lights of neuroimaging – and uncritically accepting conclusions drawn from it."[11] He coined the word *neurorealism* to describe this form of credulousness. The same can be said to nanotechnologies: we are like moths, lured by the flickering lights of nanoimaging (e.g. scanning tunnelling microscopy or atomic force microscopy) – and uncritically accepting conclusions drawn from it. Moreover, the word *nanorealism* can be used to describe this form of credulousness.

Based on the neurorealism of the general public, *neuromyths*[12] (i.e. pseudoneuroscientific theses concerning neurotechnology) are thriving. In order to prevent the propagation of neuromyths, we need to establish *neuromythology*: its job is to collect and classify neuromyths and to elucidate the mechanisms and ways in which neuromyths are brought into existence. Then the process of *deneuromythologization* is necessary, i.e. we have to make a distinction between what is neuroscientifically evidenced and what is not, and to criticize and reinterpret neuromyths.

7. Gilbert Ryle, *The Concept of Mind*, 1949.
8. Arthur Koestler, *The Ghost in the Machine*, 1967.
9 Roskies, Adina, "Neuroethics for the New Millennium" in: *Neuron,* 35, 2002, pp. 21-23.
10. Schummer, Joachim, "Nano-Erlösung oder Nano-Armageddon? Technikethik im christlichen Fundamentalismus" in: Nordmann, A. et al. (eds.), *Nanotechnologien im Kontext*, 2006.
11. *The New York Times*, Dec. 9, 2007.
12. OECD, *Understanding the Brain: The Birth of a Learning Science*, 2007.

Nanotechnologies, promoted by futurists like Drexler, science fiction writers, and visionary scientists, are similarly full of futuristic speculations and *nanomyths* so that we need to establish *nanomythology* and to collect and classify nanomyths in order to elucidate the mechanisms and ways in which nanomyths come into being. Furthermore, in the process of *denanomythologization*, we need to make a clear distinction between what is nanoscientifically evidenced and what is not, in order to criticize and reinterpret nanomyths.

We are living in the age of freedom of speech and religion (including *technoreligion*), so it is extremely difficult to prevent the propagation of *technomyths* (including neuro- and nanomyths). Scientists and technologists are expected to acquire *socioliteracy*, i.e. responsibility for social implications of their words, as part of the professional ethics of scientists and technologists. Laypeople are also expected to acquire *technoliteracy*, i.e. rudimentary knowledge of *technomythology* etc. and to take care not to fall into technocredulousness too easily. If scientists and technologists acquire socioliteracy and laypeople acquire technoliteracy, it will be easier for us to participate proactively (i.e. not reactively after a catastrophe, but before that, upstream) in the discussion concerning the democratic governance of science and technology based on the individual vision of our future human society. ■