Human Beings and Robots: Towards a Symbiosis? A 2000 People Survey

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ABSTRACT

In this paper we address the question of how robots and information technologies are changing our lives and to which extent people are ready to share their life and their body with robots. We present the results of a comprehensive survey with more than two thousand participants which allows for a statistically well founded discussion of the questions of interest: in the so-called information society, are we going to evolve in symbiosis with computer technologies? If yes, is there a limit to what we can accept?

1. THE INFORMATION SOCIETY

In the so-called "Information society", information technologies are assumed to radically change our way of life. In this joint work with a background from anthropology and robotics we pursue the question of how far people agree in accepting to live in a world of advanced information technologies such as personal robots, neuroprotheses or wearable computers.

This is usually taken for granted that we already have entered the information era which implies living in a radically new kind of society[i] as the upcoming «World Summit on the Information Society» (WSIS) suggests. Now organized by a Committee established under the patronage of Kofi Annan, the summit was initially mentioned in a resolution of the International Telecommunication Union, in order to be organized by the United Nations. According to its web site the summit's challenge is: "the modern world is undergoing a fundamental transformation as the industrial society that marked the 20th century rapidly gives way to the information society of the 21st century. This dynamic process promises a fundamental change in all aspects of our lives, including knowledge dissemination, social interaction, economic and business practices, political engagement, media, education, health, leisure, and entertainment. We are indeed in the midst of a revolution, perhaps the greatest that humanity has ever experienced. To benefit the world community, the successful and continued growth of this dynamics requires global discussion and harmonization in appropriate areas" [18].

In such a context, it is easy to understand that the idea of a «digital divide» between the «haves» and the «have nots» frightens people who are convinced that the access to the new information and communication technologies – and especially the Internet – will provide everyone with everything they need. On this point too, recent and less recent authors are afraid that a digital divide will be difficult to avoid [4], [6], [9], [10]. Thus, the goal of the first step of the WSIS (Geneva, December 2003) is trying to obtain a consensus (between different countries, the business world and the civil society), and to develop some operative action plans. The second step (Tunis, 2005), will focus on the evaluation of results.

The work referenced above study this group of questions and we also believe in their importance. In this paper, however, we will discuss the relation between human beings – as embodied – and new information technologies such as robot technologies which allows information to flow without a human body as interface. In our view, the information society is characterized by an increasing speed in accessing information. According to Virilio [15], the history of humankind has seen three major revolutions that point towards an ever-increasing speed in getting in touch with the world. The first one, that is transport, allowed humankind to master space, by achieving the ability to move through it.

[i] Although there is considerable literature on the information society, the authors who study its fundamental basis are very rare. See [3] and [13].

The second revolution, that of transmission or communication, permitted a mastery over time, and allowed elements of mankind's environment to reach him/her faster than if he/she were forced to move him/her-self in order to obtain them. And the third revolution, that of transplantation, shortens the process even more by directly incorporating the information into the organism [7].
The development of robotics during the last decades indeed confirms this observation. The field of robotics lead to a number of different robot types such as industrial robots, personal robots, service robots, robotic prothesis or neuroprosthesis. Besides the chronological or functional taxonomy we can also read this development as a constantly *increasing nearness of robot and man* [15]:

Industrial robots are stationary machines which execute specific, mostly repetitive tasks. Typical properties are efficiency, accuracy, reliability and power. Historically, they hold prime position and are nowadays mostly used in great numbers in automated manufacturing. As a part of the wide domain of automation technologies, they denote the relationship “robot – society”. The distance between man and machine is at a maximum.

Personal robots are analogous to personal computers machines appointed to one or more persons. They are defined as robots which share physical and emotional spaces with the user. Their working field lies in everyday areas: business, household and recreation. Personal robots are characterized by interactivity, autonomy, intelligence and a close link to man. They denote the relationship "robot – individual". The distance between man and machine is close to but greater than zero.

Cyborgs (from cybernetic organism) are systems whose functions are based on an irreversible union of an organic-human and technical subsystems. Typical properties are biocompatibility, distributed intelligence and partial autonomy. Examples include pacemakers, mechatronic limbs, hearing and optical aids directly attached to the nervous system or wheelchairs for the seriously disabled. The distance between man and machine disappears.

For the anthropologist, such an evolution is important: what are human beings going to become in the era of human and computer hybridization? To tackle this issue, two worthwhile questions can be raised:

- Firstly, it is interesting to study those engineers involved in the construction or implantation of technical subsystems into the human body. It is important to understand how they consider a human being, i.e. what is their notion of man when they construct our future. Where are the boundaries of mankind from their point of view?
- Secondly, in order to learn whether the engineering point of view is shared by people outside of their laboratories, we might question the man-in-the-street.

This paper presents results of a survey of significant size which investigates to which extent are people prepared to be approached by robots, and how far are they willing to share their life and their body with robot technology.

2. THE FIELDWORK

This section introduces the context and method of the study. Results and their discussion follow in the last subsection.

2.1. CONTEXT

The Swiss National Exhibition is a major national happening and takes place once in about 40 years. The last edition, Expo.02, went from May 15 to October 20, 2002. Among the 37 exhibition pavilions, the pavilion “Robotics”, produced by the Autonomous Systems Lab, EPFL, was intended to show the increasing closeness between man and robot technology [17]. The central visitor experience was the interaction with ten fully autonomous, freely navigating mobile robots on a surface of 315 m^2. Their task included tour giving, entertaining and picture taking of visitors.

Figure 1. *A small group of visitors interacting with a robot (right), one of the ten robots ready to guide visitors through the pavilion (left).*

Technically, the exhibition was the biggest project of its kind ever realized as no comparable event in

a similar setting or scale has been done before. The pavilion counted 686,405 visitors during the five-month period and the robots drove an overall distance of 3,316 km[ii].
The exhibition's main message (increasing nearness of man and robot technology) was enacted in a way that the robots did not appear "more intelligent than they are". The exhibition aimed at a credible and realistic presentation of today robot technology beyond speculation and science fiction.
A typical visit duration in mass exhibitions of this kind is between 15 to 20 minutes on average. No expert knowledge is acquired in such a short time but people were sufficiently sensitized for the subject. This was a unique condition for our survey.

2.2. METHOD

Visitors were asked to answer a questionnaire of 19 questions at the pavilion's exit. During the days in the field, about 2042 persons participated the survey.
The results were quantitatively analyzed with SPSS (Statistics Program for Social Sciences) and they were confronted with some hypotheses issued from a previous qualitative research focused on the engineers' points of view.

2.3. RESULTS

We will focus on a selection of questions focused on the third phase of the development of robotics (section 1), i.e. the integration of new information technologies into the human body. The first theme linked with this topic is divided in three gradual questions (1-3). It concerns limb prostheses, i.e. external prostheses.

1) *In case you loose a limb (arm, leg, hand, foot) due to a handicap, accident or disease, would you accept to have it replaced by a conventional prosthesis?*
- 68.8% answered yes
- 23.8% did not know
- 7.4% answered no.

2) *In case you loose a limb (arm, leg, hand, foot) due to a handicap, accident or disease, would you accept to have it replaced by a robotic prosthesis (with motors, sensors and microprocessors)?*
- 74.6% answered yes
- 20% did not know
- 5.4% answered no.

3) *Still in the same situation, would you accept to have it replaced by a prosthesis directly connected with and controllable by your nervous system?*
- 61.2% answered yes
- 27.8% did not know
- 11% answered no.

All acceptance percentages are relatively high, especially the one which concerns the robotic prosthesis where only around 5% of the participants said no.
These results further show that people are not afraid at all of having an artificial limb in general. Moreover, they prefer new technologies than older conventional prostheses. Nothing new; it confirms that our western societies trust in technology, and new information technologies in particular, when to solve problems, as the following question confirms:

4) *What is your image of robotics?*
- A good image,: it is there to help mankind, for its benefit (28%).
- A bad image: it constitutes a danger, it replaces man (2%).
- A neutral image: everything depends on what is done with it (72%)

This was surprising to the authors. Not too long ago, robotics was widely associated with the image of a technology which causes structural unemployment rates to increase. Nowadays robots, especially personal robots, are more and more employed in our daily life as our assistants. Examples include: autonomous vacuum cleaner, lawn mower, toy, entertainer, health care domain. We believe that this development partly explains this attitude.
It further supports the observation that technology seems mainly to be considered as neutral. According to this point of view, technology is not intrinsically seen as good or bad: the user is good or bad.
However, from an anthropological perspective, we can say that every technological system does not appear by chance at a certain moment and in a certain society. Technology is linked with social values and what is considered as precious can change according to these values. We would like to shed light on some values related to our questions.

[ii] For details, please refer to our publications on the robot system [16], the navigation system [2], and the interaction system [12]. The topic of robots in exhibitions has been addressed in a more general context in [1].

For instance, if the idea of a prosthesis seems to be welcome for most people, the connection with the nervous system makes the acceptance percent decrease. Why? A hypothesis could be that people accept prostheses remaining outside their bodies and not inside. However, the answers to the next questions (5-6) exclude such an explanation. They are related to the integration of artificial organs.

5) *In case of disease or injury, would you accept an artificial organ to replace your disabled organ, if your* life *would depend on it?*
- 74.2% answered yes
- 18.3% did not know
- 7.5% answered no

6) *In case of disease or injury, would you accept an artificial organ to replace your disabled organ, if your* quality of life *would depend on it?*
- 58.7% answered yes
- 30.3% did not know
- 11% answered no

The acceptance percentage decreases for the quality-of-life-question, but we can notice, as already stated for limbs, that it is almost taken for granted that an artificial organ can perfectly replace a natural organ.

Human bodies are in our societies more and more carved by science, technology, medicine, diets, sports activities and so on. Moreover, there is nowadays a strong tendency to try to reproduce every organ with artificial elements. Even if we still do not know exactly how some organs work, we will certainly know one day. And we will be able to construct an imitation / simulation of them.

Our results confirm that human functions are considered as physical processes which could theoretically be imitated. Relations between the different elements of the whole are considered as directed by an informational code, the mastering of which should theoretically allow reproduction with other matter atoms. Wiener [20] was sure that physical identities are a kind of message, which means special patterns characterized by their special role of information vectors from a close or far point to another one. He suggested that it would one day be possible to telegraph a human being**.** Teleportation, as it is especially known in Star Trek movies, was theoretically born with the idea of being able to move through the space without moving any material element ! It translates very well the idea that to be efficient, matter has "just" to be organized in the right way: our limbs' and organs' quality does not depend on what they are materially made (animal cells, human cells or technical elements) but on how these elements are organized.

Let us cross these results with another question's result. The question was:

7) *Do you think that the robots you just have seen are intelligent?*
- 32.1% answered yes
- 11.5% did not know
- 56.4% answered no

This answer – only 32% yes – (possibly disappointing for the engineer) is also influenced by the way robotics was presented in the exhibition. As mentioned, it was a maxim of the exhibition's scenography to show today robot technology "as is". A malfunctioning robot (which happened occasionally) was equally part of the exhibition as its well working colleagues.

Crossing the results, we discover that the variable "intelligence" and the variable "robotic limb" are statistically highly linked (Chi-square(4)= 38.58, $p<.001$). The variable "intelligence" is equally linked with the variable "robotic neuro-prosthesis" (Chi.square(4)= 49.62, $p<.001$).

People who think that the exhibition robots were intelligent would accept a robotic limb prosthesis (both types) in the same proportion than people who think that the robots were not intelligent: more than 76% (respectively 76.8% intelligent and 76% not intelligent) would accept the "simple" robotic prosthesis and around 63% (respectively 64.1% intelligent and 63.1% not intelligent) would accept the prosthesis linked with the nervous system.

However, people without a clear opinion to the intelligence-question are less positive: 60.4% of acceptance for the robotic prosthesis and 42.3% of acceptance for the brain-linked prosthesis.

With the organ-related questions (question 5 and 6) we obtain a similar distribution: Regardless if they consider the robots as intelligent or not, relevant is whether they have a clear opinion.

In our view, these results show that the important problem for people is to first give a meaning to the robot, which in turn helps to give a meaning to the prosthesis. And given that people's attitude is clear towards these technologies (especially the neuro-prosthesis), they have the tendency to agree more than the others.

We can connect such a result with the fact that the general percentage of acceptance decreases if the nervous system is involved.

Such a decrease seems coherent to us. Indeed, the increase of available information (for example by neuro-prostheses) underlines the importance of the mind and goes hand in hand with a depreciation of the body: the human body is often regarded as an impediment to the free circulation of information. It is taken for granted by some people that we would be faster and more efficient without a body and with only a free mind stuffed full of information. That is (still?) more of an imaginary trend than of a palpable reality, but it is worth noticing that such a belief, that we can function without a body, is perfectly coherent considering our Western values and practices. The Internet demonstrates this phenomenon very well: the intention is to connect people's brains. That is not a surprise, because we can see that networks in general, as the history of the term demonstrates, produce an effect of disembodiedness. The term «virtual», principally used in the early '90s to describe experiments conducted under the rubric of «virtual reality», has increasingly been applied to the Internet as a whole and to networks in general. However, on closer analysis it appears that these phenomena, all described as «virtual», rely on very different representational logics. While virtual reality attempts to put the human body into a new experimental space, networks produce an effect of disembodiedness, represented by the notion of the purely cerebral person for whom the body is a handicap that limits the free circulation of information.

«People in virtual communities do just about everything people do in real life, but we leave our bodies behind. You can't kiss anybody and nobody can punch you in the nose, but a lot can happen within those boundaries» [14]. The network is thus a disembodied representation of life in society. For instance, the electronic vote allows you to vote without leaving home. We try to solve the non-voting problem, as if the problem was only that people don't want to move their body; as if it was only a technical question and not a social problem.

This trend to eliminate the body is apparent everywhere: four years ago, newspapers mentioned a disabled man whose brain was directly connected to a computer (Le Monde, 6th of December 1999, p. 12, our translation). Electrodes implanted in his brain were able to detect the waves produced when this man was thinking. Signals were picked up by a radio antenna and transmitted to a computer which interpreted them as if they were coming from a computer mouse. It was reported that after a few weeks of practice, the patient was able to think «I am moving the cursor», without first thinking «I am moving my hand in order to move the cursor». That last mental activity was described as a transitory step. Thus, the option seems clear: the goal is neither to allow the patient to be mobile again, nor to give him, at least, the awareness of his body. On the contrary, his body is considered as totally useless. One could object that this patient is a disabled subject, whose body is not mobile and thus not an example of what a valid human could become. We would grant that it is not exactly the same situation, but there is a fundamental logic which is the same. According to Melody Moore - the person in charge of the computer part of this project -, "the more direct the interface is, the more efficient it is". This patient appears to me as a kind of prototype for a world in which brains and computers would be directly connected to each other without any bodily interface.

In such a context, our humankind and our self are exclusively defined by our mind. It can explain that it is more difficult to accept a prosthesis linked with the nervous system. And it can explain too why people who do not know if robots are intelligent hesitate with the idea of such a prosthesis.

A last question shows how far our participants would accept – or at least say that they would accept – to go:

9) *If it were technically possible and if it were safe, would you accept to have your mobile phone implanted directly into your brain provided that you can switch it off*?

- 15.2% answered yes
- 84.8% answered no

Around 15% of acceptance is not a high rate, but it seems terribly high considering the “odd” question!

If we cross this results with the variable "age", we see that they are statistically linked: Chi-square(6)= 48.16, $p<.001$.

Younger people have the tendency to accept this idea: 26.9% people younger than 18 years answered yes. The percent decreases between 19 and 55 years around 12%. But it is remarkable to note that it increases again for elder people (more than 55 years): around 19%.

3. CONCLUSIONS

Our results confirm that our nervous system (and our brain) is considered as most important, which is

coherent with our social values in the information society: intelligence over body. As matter, the body is considered as a perturbation of the seamless flow of information.

However, the majority of our questions have shown that people accept easily to have their organs and limbs replaced by artificial substitutes. Body seems important.

It could be considered as a contradiction to want to eliminate the material part of human on the one hand and to reproduce it on the other hand. What seems to be a paradox at first glance has an explanation if considered in detail: to be able to create organized matter (e.g. constructing robotic prostheses) means that we must know what we call the informational "code". In both cases, information is considered as the essential element, which we have to master [4].

There is no longer a classic Cartesian split between body and mind: the most important split is between the material dimension of both body and mind (often considered as a set of chemical processes) on the one hand and their translation into information on the other hand.

Information society is defined just as well by information and communication technologies – which permits us to communicate without using the body, as by biotechnologies – which permit us to modify matter [5] and [11]. And the two together allow us to create everything.

Our results confirm that we have a love / hate relationship with our body: we sufficiently hate our body that we want to eliminate it and we sufficiently love our body that we strive for its reproduction.

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