

# Do we want to share our lives and bodies with robots? A 2000-people survey

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## Abstract

*For roughly two decades a new generation of robots, robotic prostheses and implantable devices is about to arise accompanied by great optimism that they will widely pervade our daily life in a near future. This paper presents the results from a survey on the question if people want to share their life and body with robots. The survey, carried out in connection with the “Robotics” exhibition at the Swiss National Exhibition Expo.02, counts over 2000 participants. The questionnaire covers issues on robotics in general, service and personal robots, robotic prostheses and artificial organs. While the results testify a positive attitude towards potential robotic co-workers, flat-mates or body part, they include a number of surprising answers.*

*We find correlations in the data, discuss interpretations, speculate about the answers and cultural influences and finally conclude: Whom are we building robots for and what should they be like? To whom are we selling robots and how should we market them?*

## 1 Introduction

The field of robotics is undergoing a paradigm shift which is usually subsumed as “from the factory into service and our homes”. A new generation of robots that operate in service applications, domestic environments, the entertainment domain or in the human body is being developed in public and corporate research laboratories all over the world. These robots will change the way we grow up, play, teach, work, pursue our life-style, entertain ourselves, interact with machines, animate our surroundings, get old, care, or alleviate handicaps. That this development takes place right now testifies, for instance, the press release from the US-based company iRobot published in October 2004 (*iRobot 2004*): “One million Roomba robots sold”. This is a record for an automatic vacuum cleaner in particular and for a domestic robot in general. The latest forecasts from the United Nations Economic Commission for Europe (UNECE) and the International Federation of Robotics (IFR) predict a significant growth for service and personal robots within the next years (*UN 2004b*).

Historically, industrial robots are often seen in prime position but they have few things in common with the ideate and real precursors of robotics. Artificial creatures that populate our myths, fairy tales and stories are personal assistants (Hephaistos’ golden maids), lovers (Galatea in the Pygmalion myth), servants and guards (Golem), results of scientific obsession (Frankenstein’s monster) or friends and protectors (Pinocchio, Astroboy) to name a few. The first mechanical automata in Ancient Greece, Arabia, India, China and the remarkable life-like creatures of the European Baroque (e.g. Vaucansons duck) and the Edo period in Japan (e.g. tea-bringing doll) had been built for entertainment purposes. None of these early robots were meant to be anonymous laborer in places far from daily life. So rather than being offsprings of robotic assembly line workers, the new generation of robots are a resumption of our early ideas of artificial creatures. And when one day – provided a few scientific and technical breakthroughs – they measure up to the glamorous icons which walk across our movie screen, the circle gets closed.

Therefore the arrival of robots in our daily life has been anticipated long before they finally set foot into our homes. The mere existence of (real) robots does not come as a surprise to the man-in-the-street. But going further, how far is he or she ready to accept a robot in his or her daily life? Do people embrace this development at all? And if so, who does? And under which conditions? Are they also willing to share their body with robots in the form of prostheses and artificial organs? Where are the limits? These are some examples of what an engineer interested in the social issues related to his work and an anthropologist specialized in the relationship between technology and society were separately wondering until they decided to join their efforts in order to obtain answers.

Answers to these questions would give us more information whom we are actually building robots for and what they should be like. The roboticist would have better guidelines for the robot's appearance, user interface or personality design. The answers would also enable robot companies to know to whom they are selling robots. And from knowing the conditions under which robots get accepted they could derive appropriate sales strategies for the target markets.

From an anthropological perspective, human values are always embedded in technological devices. Thus, contrary to accepted ideas, technology is never neutral – it is a mirror of the society. From this viewpoint robots are created according to what is important in the social group where they are built and represent a kind of externalization of human abilities. They are not the exact replication of mankind but only of some selected aspects of it. Studying these aspects shows what is considered as important. Further, robots have a very strong symbolic impact, as once robots do exist, humans redefine themselves in comparison with them. Thus, knowing more precisely what people think of robots as well as their expectations for the future of robotics gives us also a better idea about how humans describe themselves, and that is a main anthropological issue.

## 1.1 Related Work

Surveys are an important technique used in social science and human-computer interaction research. There is numerous work in this area but few in the field of robotics. Earlier surveys have been rather small and specific in scope and context. A majority has been carried out in the field of rehabilitation robotics, others in the context of robotic tour-guides. In conjunction with DEVAR IV, a robot manipulator system for assisting the disabled at home-based or vocational workplaces, 24 disabled persons have been interviewed to determine the quality of the robot performance and the reaction of the disabled users (*Hammel et al. 1989*). In the frame of the European project MOVAID, coordinated by SSSP Pisa, Italy, a user need study for a mobile robotic assistant for disabled and elderly people has been carried out (*Dario et al. 1999*). The study surveyed 145 elderly and disabled persons on their domestic environments such as the kitchen and bedroom. A table-top robotic assistant was evaluated by 13 elderly and disabled subjects in (*Johnson et al. 2003*). During a two-week deployment of the tour-guide robot Minerva (*Thrun et al. 2000*), a poll with 63 subjects has been conducted to determine the robot's popularity and perceived intelligence.

A strong link between the interviewee's foreknowledge and their acceptance has been observed in (*Hammel et al. 1989*), (*Dario et al. 1999*) and (*Johnson et al. 2003*). Subjects who knew more about robots had a clearly more positive answering behavior. As soon as additional information had been given or after subjects could see or interact with a robot, a majority of participants who were negative or undecided before changed their mind.

This shows the importance of a minimal knowledge of robots for user studies of this kind in order to avoid the pitfall "I dislike what I don't know". For this purpose, the questionnaire of (*Dario et al. 1999*) contained iconographical material (images of different robots) and in (*Johnson et al. 2003*) participants were shown a slide-show presentation. In our work subjects are contextualized by the exhibition, described hereafter.

## 2 Context

The survey has been conducted in conjunction with the "Robotics" pavilion at the Swiss National Exhibition Expo.02. Swiss national exhibitions take place roughly once per generation and are major cultural and social events. They are similar to world exhibitions such as Expo 2000 in Hannover, Germany, or Aichi 2005 in Japan. Expo.02, the fifth edition in a row starting in 1873, had 4.2 million tickets sold and counted 10.3 million entries during the five months from May 15th to October 20th 2002. There were 37 exhibition

pavilions which covered a wide range of topics such as sustainable development, food and nutrition, water, love and marriage, biochemistry, robotics and many others. During a typical visit at Expo.02 people went to see several exhibitions, rarely a single one and rarely all of them.

The robotics pavilion – called “Robotics” – was one of these 37 exhibitions. Its main message was the increasing nearness of man and robot technology. The central visitor experience was the interaction with eleven freely navigating, interactive robots (figure 2.1). The scenography – the way the exhibition’s message was implemented – emphasized a neutral and transparent illustration of today robotics and avoided deliberately speculations, science-fiction and any form of AI-prophecy. This maxim found expression in various ways, for example in the design of the on-site laboratory as a showcase whereby a broken robot or a robot which is being reprogrammed was equally part of the exhibition.

The robots’ tasks included tour giving, picture taking and entertainment (reciting poetry, music box, etc.). During the five months non-stop operation, “Robotics” had 686,405 visitors. A typical visit duration for mass exhibitions is between 15 to 20 minutes. The pavilion was authored and realized by the Autonomous Systems Lab from EPFL. The technical aspects of deploying a team of autonomous robots in a mass exhibition have been described in several papers: (*Arras et al. 2003*) for the navigation systems, (*Jensen et al. 2002*) for the interaction system, (*Tomatis et al. 2003*) for system integration aspects, (*Siegrwart et al. 2003*) for the project and (*Arras and Burgard 2002*) on robots in exhibition-like contexts in general.



**Figure 2.1.** Scenes from the “Robotics” exhibition at Expo.02. One of the eleven Robox robots in front of an exhibit (left), interaction with a small group (center), interaction with a big group (right).

## 2.1 Methodology

Given the number of participants we wanted to question, we followed a paper-and-pencil method to conduct the survey. Visitors of “Robotics” had been asked at the pavilion exit whether they wanted to participate in a survey on robotics. If they agreed, the questionnaire was handed out allowing people to take their time to answer the questions. We were in the field at different weekdays during the five-month period of Expo.02. The questionnaire did not contain any pictures or supplementary material (see Appendix). As Switzerland is a multi-language country, there were questionnaires in German and French. A total of 2042 subjects agreed in participating the survey.

The data were quantitatively analyzed with SPSS (Statistics Program for Social Sciences). We do not mention the chi-square values for the sake of readability. But each crossed variable result which we will discuss in this paper is statistically significant at levels of  $p < 0.01$  or better. This means, that the risk of error when interpreting the variables as statistically linked is less than 1%. Cross analysis results that had too small numbers of subjects involved to be statistically reliable have been dropped.

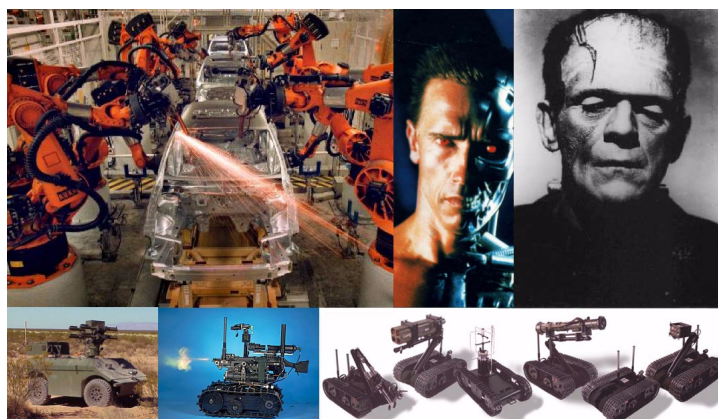
### 3 Questions on Robotics in General

This group of questions aims at the general perception of robotics in the public. Is there a belief for a potential contribution to one's personal wellbeing and happiness, and what qualities do robots have in comparison to human beings?

#### 3.1 Image of Robotics

The first question is “what image of robotics do you have?” with three possible answers “yes”, “no”, and “I don't know” (question 1). At first sight, like other technologies, robotics has the potential of a good and a bad use. There is reason for skepticism or rejection (figure 3.2):

- Robots replace people at work. This is a fact and still a popular picture.
- They are man-made “beings”. In the Christian tradition they question the divine privilege of creation.
- Robots could become a competitor of man and question his status as the creation's crowning glory. This diffuse anxiety for robots called Isaac Asimov the “Frankenstein complex” (*Asimov 1947*). And indeed, in many stories with fictional robots, they go astray, get out of control or turn against their creators, often with a catastrophic ending. Golem, Frankenstein, Karel Capek's R.U.R., or Terminator are just the most popular examples.
- Robots are more and more being used by the military. Their tasks also include lethal missions.



**Figure 3.2.** *Robotics, a technology with a bad image?*

On the other hand, robots and particularly the new generation of robots carry a positive message (figure 3.3):

- Robots can assist people, entertain them, and ease their lives
- Fictional robots of good nature exist as well: Pinocchio, Johnny 5, R2-D2 and 3-CPO, or Tetsuwan Atomu (Astroboy)
- Robots save human lives when they go to places which are unreachable or dangerous

Or, at last, is robotics seen as a neutral technology since everything depends on what is done with it?

Considering the answers we can state that this is the dominant opinion. 71% have a neutral image of robotics, 28% a good image and 2% a bad one.

When crossing the data with language and gender we obtain strong deviations from parity: 23% of the German-speaking subjects opposed to 38% of the French-speaking participants make up the good-image-group of 28% (accounting for their representation in the sample given in section 7). But this does not mean that German speaking participants have a worse image of robotics – both are at 2% bad image – but that



**Figure 3.3.** Or with a good image?

they have a more neutral image: 75% versus 60%.

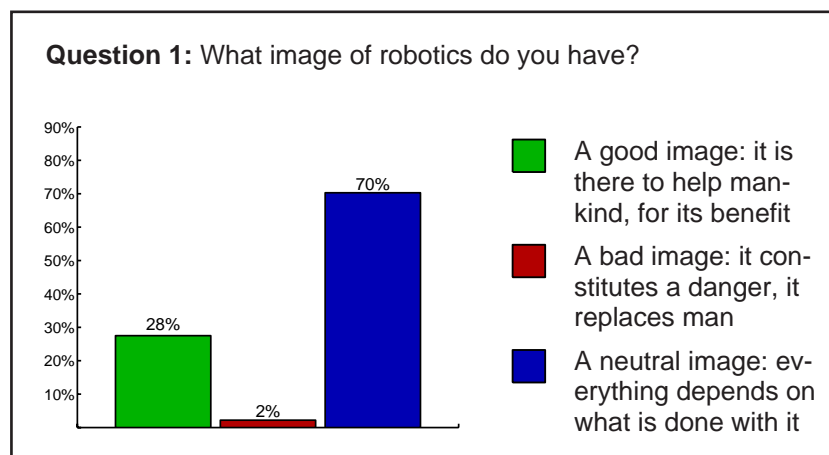
Regarding gender we find that the green bar in question 1 is comprised of 70% men. Given their representation in the sample, 34% of men have a positive image of robotics versus 19% women. Both groups are at 2% to have a neutral image while 78% women have a bad image against 64% men.

Further, the older people get the better their image: starting at 22% of participants below 18 years the positive image increases monotonically to 39% for elderly people above 55 years.

### 3.1.1 Discussion

A bad image for only 2% of the participants is a remarkably small percentage. We conclude that robotics is no longer seen as a “job-killer” technology, and further, that robots do not evoke anxieties in the sense of Asimov or a feeling of religious discomfort. In the dominant opinion, robotics is rather considered a neutral technology as such.

The deviations across language, age and gender are noteworthy. Nobody would be surprised to state different perceptions between culturally distant parts of the world. But here we are on a language border within the same country. In the distribution over age, not young people, familiar with high technology, show the highest acceptance rates but the lowest. And the tendency is clear: the elder people get the more positive becomes their image. The deviation between the genders is strong. Men seem to have a considerably better image of robotics than women with 34% versus 19%. Before discussing possible reasons for these attitudes, we shall examine more material.



People seem to think that a good or bad application of robotics is not inherent but is introduced either by its usage or user. This is not surprising as the common view of technology is a neutral one. The user is considered as the sole responsible. This is sometimes illustrated with the hammer as a tool to knock in a nail (considered as “good”) or to strike a person (considered as “bad”). From an anthropological perspective, we consider that even the “bad” use is just one application of what the designer/engineer – and most people living in the same society – believe in. A technological system does not appear by chance at a certain moment and in a certain society. People who build robots have – like all of us – assumptions on what human beings are (it is a descriptive aspect) and what they are supposed to be (it is a normative aspect). These values are embedded in the robots they produce, even if they are not always aware of it. This means that the creators have a partial responsibility in what is done with the objects they build. A reflection on ethical issues related with robotics should take this into account.

## 3.2 Welfare and Happiness Through Robotics

The next two questions are “do you think that robotics can contribute something to your personal welfare?” (question 2) and “do you think that robotics can contribute something to your personal happiness?” (question 3) with both three response categories “yes”, “no” and “I don’t know”.

For the welfare-question 69% of the participants answered yes, 19% no and 13% were undecided.

Crossing the data with language reveals a more positive attitude from the German-speaking participants where 71% voted yes versus 63% of the French group. 25% of the Francophone subjects and 16% of the German-speaking participants compose the 19% group of no-answers. Concerning gender, we find that 75% men versus 62% women make up the 69% yes-answers – a difference of 13%. Cross analysis with the image-question shows that 81% of subjects with a good image of robotics believe in welfare through robotics versus 12% who do not. The group with a negative image of robotics is least positive and has a distribution of 27% no and 51% yes. For the neutral group, two third, 66%, think that robotics can have a contribution to their welfare versus 20% who do not.

For the happiness-question the general response behavior was clearly less positive: 28% yes, 52% no and 20% I don’t know.

In comparison to the welfare question, differences are accentuated. For gender we find that the 28% positive answers stem from 34% men versus 22% women – almost the same difference than in the welfare-question (12% and 13%) but at smaller absolute values. 38% of the subjects in the French-speaking group voted yes versus 25% in the German-speaking fraction. For the 52% no-answers the distribution is accordingly inverted: 55% versus 44% for the German and the French group respectively. The most positive age group for the happiness-question are elderly people above 55 years with 36%, followed by teenagers and kids below 19 years with 32%. Adults are least optimistic that robotics can contribute something to their personal happiness.

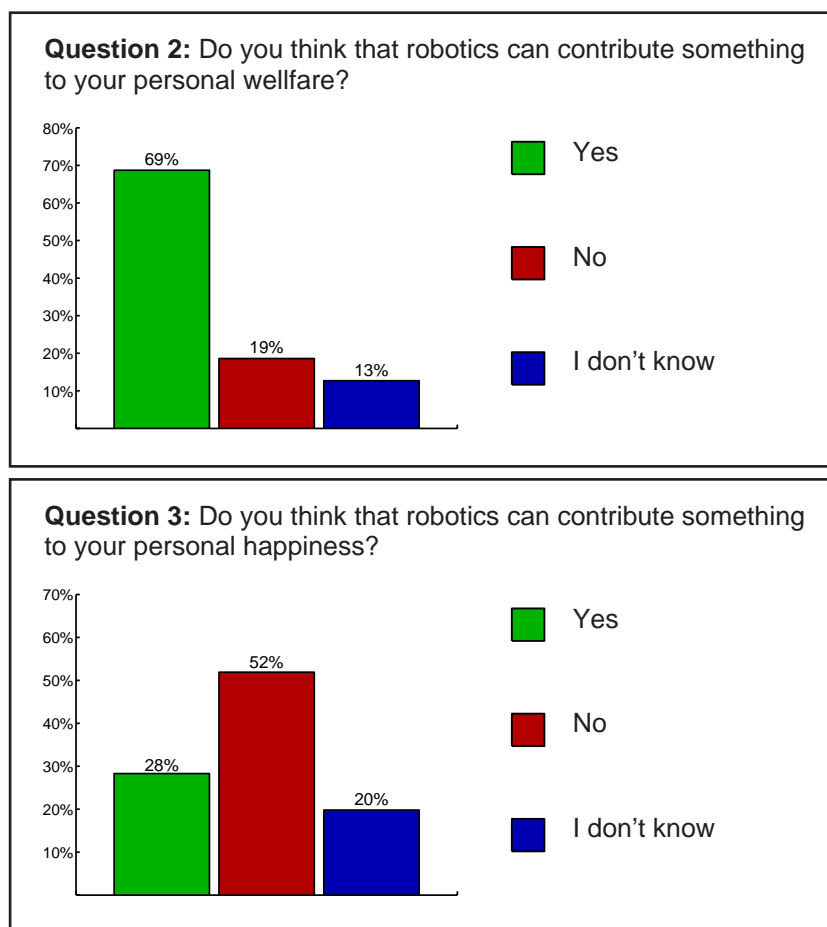
Cross analysis with the image-question shows that 47% of subjects with a good image said yes and 33% said no to happiness through robotics. The group with a negative image of robotics clearly rejects the belief in happiness through robotics, 71% no versus 11% yes, and the neutral group has a distribution of 22% yes to 59% no.

87% of the participants who said yes to the happiness-question said also yes to the welfare-question. But they represent only 36% of the green bar in the welfare-question.

### 3.2.1 Discussion

We state a strong general belief in a potential contribution to personal welfare through robotics. It appears





that the message carried by service and personal robots has arrived in the public, and once more, we find no evidence that robotics has a negative reputation. Second, people make a sharp distinction between welfare and happiness: acceptance drops from 69% to 28%. Note also that one fifth is undecided in the happiness-question.

German-speaking participants continue to be more reserved. Albeit they believe more in a contribution to one's welfare than their fellow French speaking citizen (71% to 63%), they are disproportionately more pessimistic in the happiness-question: 25% versus 38% – a difference of one third from above.

Men are more positive in both questions: 75% versus 62% for welfare and 34% versus 22% for happiness. Whereas the absolute difference is constant – 13% and 12% respectively – the divergence in the latter case amounts to 50% more men than women.

For the happiness-question we find the oldest age group to be most optimistic again. A result which can be seen as evidence that people see robotics as a technology with the potential to satisfy the needs of elderly people. We will come back to this thought further below.

When crossing the two questions with each other, we find an expected strong correlation confirming the hierarchy between the two terms: happiness is stronger and contains welfare. The answers show that you cannot have happiness through robotics even considering it as neutral: 80% of the subjects who answered no in the happiness-question say that robotics is neutral. They seem to think that even the best usage of robotics is unable to bring happiness by its own. Personal welfare, on the other hand, is easier to obtain. Two third (66%) of the participants who say that robotics is neutral believe in welfare through robotics. Despite their neutral attitude, they seem to believe that, contrary to happiness, personal welfare can be the result of a good use of robotics.

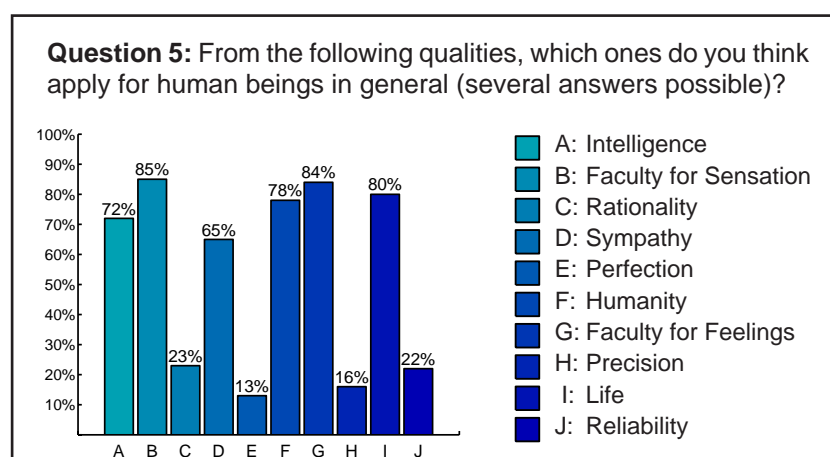
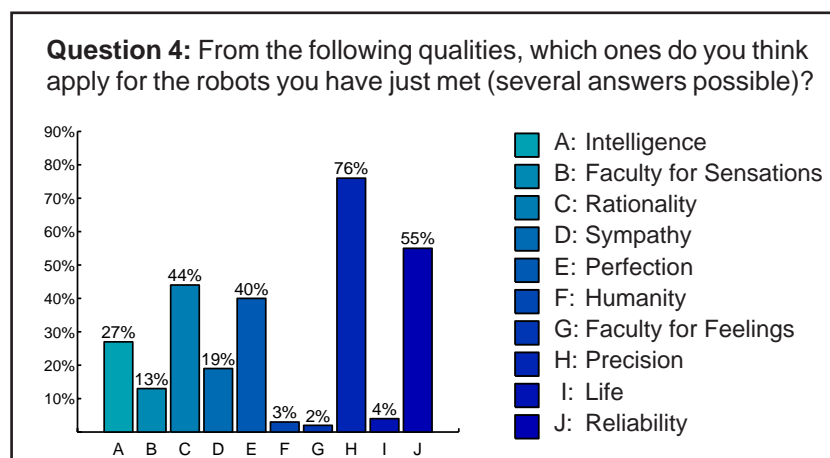
Those who promote the so-called information society and make bright future predictions with robots in every household should consider these answers as they usually take for granted that technology is the salvation for everyone's worries: the new technologies are supposed to change our way of life and bring health and happiness. At least for happiness our subjects seem not to share this view.

### 3.3 Qualities of robots and humans

In the following two questions we asked the subjects to name attributes of robots and humans: "from the following qualities, which ones do you think apply for the robots you have just met (several answers possible)?" (question 4) and "from the following qualities, which ones do you think apply for human beings in general (several answers possible)?" (question 5). A list of ten qualities is given: "intelligence, faculty for sensations (heat, cold, pain, ...), rationality, sympathy, perfection, humanity, faculty for feelings (love, friendship, antipathy, ...), precision, life, reliability" and an open category denoted "others".

The responses are as follows: for the robots there are two salient categories: precision (76%) and reliability (55%) followed by rationality (44%) and perfection (40%). The least rated qualities are life (4%), humanity (3%) and faculty for feelings (2%). For humans there are six salient qualities: faculty for sensations (85%), faculty for feelings (84%), life (80%), humanity (78%), intelligence (72%) and sympathy (65%). In both questions the open category was rarely utilized and shall be ignored here.

When we cross the perfection data (13% for human beings) with the first question, "what image of robotics do you have?", we find that the 87% of participants with a good image of robotics and the 87% with a neutral image, and only 62% of subjects with a bad image think that humans are imperfect. If, on the other



hand, we consider the participants who voted for human perfection, we see a deviation in favor of a bad image of robotics. While the total numbers in the image-question are 28% good, 2% bad and 70% neutral, the group who thinks that humans are perfect has a less neutral and more negative image: 28% good, 7% bad and 66% neutral. Note however that statements related to the bad-image fraction are difficult as this group is small (2% or 41 subjects).

### 3.3.1 Discussion

Robots seem to be associated with almost “classical” qualities of machines: they are precise, reliable, rational, and perfect – attributes which would rather apply for industrial robots. This although question 4 had the addition “... the robots you have just met” and thus refers to our socially interactive exhibition guides. It contradicts also to the image of many fictional robots that have sophisticated personalities, far beyond the stereotype vocabulary of these four machine qualities. But the answers suggest that people seem to differentiate between fictional and real robots knowing that feelings, life or humanity is easy to pretend in a novel or on a film set but hard (or impossible) to implement in real life.

It is concluded that future robots which add new qualities such as social or emotional skills will meet an unprepared public. Feelings, sensations, the impression of life or humanity conflict with the general idea of robots. Robots are expected to do their job – efficiently and reliably – regardless if at home or at a conveyor belt. The responses confirm the perception of the robot as a tool and it appears that there is a long way to go until they are our established “companions” and “friends”.

The survey corroborates that humans are usually associated with “warm” qualities while robots are related to “cold” qualities. Thus, as robots are considered more perfect than humans, perfection seems to be related to the possession of “cold” qualities. Paradoxically as it may seem, humans are better assessed in case they have cold qualities, normally linked to machines. From an anthropological point of view this means that the “warm” qualities are no longer those which are considered best in our society.

Those who have a good image of robotics and consider humans as imperfect are the ones most likely to see technology as a kind of prosthesis which allows people to act with the “cold” qualities they are naturally poor with. And it is no surprise that the fact to consider humans as perfect slightly increases a bad image of robotics: a perfect human does not need any technological help. It is interesting to state that the contrary is not true: subjects who consider humans as imperfect do not necessarily have a good image of robotics. For this group there might be other missing qualities than the “cold” ones or they simply do not believe in human perfection regardless the technological possibilities.

Not only that we can state an assignment of “cold” qualities to robots and of “warm” qualities to humans, we also observe that the salient categories of the former are exactly the weak ones of the latter and vice versa. It appears that people make a crystal-clear distinction between humans and robots. They draw a borderline between man and machine which could not be more explicit rejecting ideas that blur this frontier such as the materialist slogan “man equals machine”. Having said this, the answers also suggest that humans and robots would actually complement one another perfectly.

The notion of perfection is an interesting one. There are old western philosophical traditions assuming that humans are intrinsically imperfect. Nowadays, with science and technology, we have powerful tools to try to reach perfection but the criteria for improvement and perfection are never absolute. They continuously evolve in function of what is technically feasible and contribute to a continuous shift in what is considered as normal (*Cerqui 2002*). The definition of “normality” evolves, depending on the scientific and technological thresholds. As a result, what is defined as a harmless and normal impairment today, might be considered as a handicap tomorrow when technology made progress in alleviating this handicap (especially because “progress” is considered a synonym to “better”, and because we often feel that we must do everything we can do).

### 3.4 Work in a Future Society

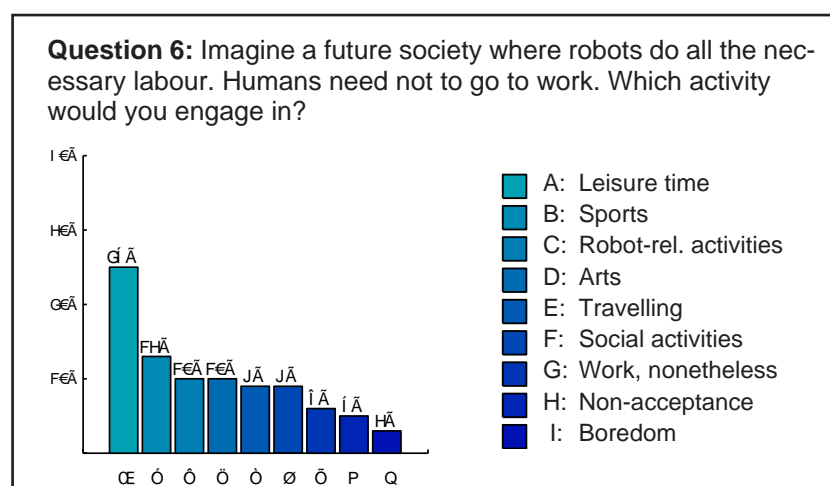
The last question in this group is “imagine a future society where robots do all the necessary labour. Humans need not to go to work. Which activity would you engage in?”. As a text open-end question the answer was left to the participants (question 6).

A vague picture of this utopia can already be found in Aristotle’s Politics (350 BC) but an adequate reference in our context is Karel Capek, the Czech writer who coined the term “robot” in his theatre play “Rossum’s Universal Robots” in 1920 (Capek 1920):

*“Within the next ten years Rossum’s Universal Robots will produce so much wheat, so much cloth, so much everything that things will no longer have any value. Everyone will be able to take as much as he needs. There will be no more poverty. Yes, people will be out of work, but by then there will be no work left to be done. Everything will be done by living machines. People will do only what they enjoy. They will live only to perfect themselves.”*

As far-fetched as this utopia seems, it is a possible outcome of our quest for higher degrees of automation in all social domains. A small randomly chosen subset of answers shall be given:

... / Ballet, motorcycling / Reading, arts, sports / Fighting against Artificial Intelligence / Sports, movies, meeting friends / Reading, sports, watching TV, eating / Unemployment! / Leisure time, relaxing, maintaining house and garden / Sports / Contemplating about the natural world which remains and surrounds us / Artist, actor, professor / Coordinating robots / Leisure time / Social work, I wouldn’t appreciate it / Extending my knowledge / Reading Isaac Asimov / Inventing other robots / Sleeping / Travelling / Boredom / Improving robots / Holidays under the sun / Being bored to do sports and travelling all the time etc. / Reading, singing, having fun / Garden work, reading / Sports / Tennis, without robot / I don’t imagine such a society! / Beach / Unimaginable / Playing, being bored / Destroying robots, too many are unhealthy / Hobbies / Arts, creativity / Repairing robots / Sports, enjoying, drinking beer / Travelling, reading / Art activities / Holidays, travelling, sleeping, then being bored / Programming robots / I don’t think this is okay / Working myself! / Taking the time to live / Sleeping, having fun / Holidays / Studying / I don’t know / Holidays / That’s the question / I don’t know / Doing nothing / Driving robot cars / I would do all the things that I don’t have time for now / Doing nothing / Holidays / Studying humans / Spiritual work / Personal development / Holidays / Suicide / All the beautiful things in life / Sleeping / Researching / Studying / Sofa / Getting essential with our unique and beautiful nature / Child raising, social work / Travelling / Music, reading / Leisure time, studying as a hobby / Constructing robots, besides no robot could do my work / Undesirable / Creative activities, painting, writing, dancing / Thinking about the catastrophe when robots get really intelligent / Botany, sports, reading, sex, travelling / Unimaginable / ...



Answers have been manually classified into nine categories which yield the distribution shown in question 6: One quarter of subjects would engage in activities related to leisure time and hobbies. 13% would go in for sports, 10% for arts, and another 10% would give their time to robot-related activities. Examples include “developing robots, selling robots, cleaning robots, programming robots, improving robots, supervising robots, managing robots, etc.”. 9% of participants would spend time on travelling, 9% on social activities and 6% declare that they would keep on working what they do now. 5% express their explicit non-acceptance of this society which goes from “suicide” to proactive aggression and 3% believe that they would get bored after all.

### 3.4.1 Discussion

We were astonished to see that the profession roboticist enjoys such a popularity. A plausible explanation for the 10% of robot-related answers could be an implicit non-acceptance of the idea that human labor is no longer required. In the search for a place where people can make themselves useful, robots seem to be the last resort (even though it is to be assumed that the tasks would be carried out by robots as well). Note the 5% of participants who declare their explicit disagreement. Ignoring them could turn out to be dangerous. According to the passion of some of their answers, members of this group could become the future terrorists in this society.

Summing up the participants who cannot imagine a society without work, who would work nonetheless, who think that it would be boring, and who would go for a job related to robots, yields 24%. This means that one quarter of the subjects refuse a society without work – a percentage which seems high considering that work is not the most joyful part of life for many people. An explanation might be related to the over-representation of participants with higher levels of education (see section 7) who usually find more satisfaction in their professional activity. 57% of the subjects would engage in activities related to leisure time, hobbies, sports, arts and travelling. A number of answers were also related to philosophical and spiritual work. This group seems to affirm our leisure-time society and would live the utopia pictured by Capek.

But in effect the questions challenges our notion of work. What is its meaning to us and what if no work is left to be done? Will we all become artists, sportsmen, players, travellers and philosophers? Will we be happier then? In a short story by (*Todesco 1995*) people play the “holistic game”, a game which simulates present-day life in which they carry out various activities such as craftsman, artist, engineer or manager. The goal is not to reach mastership in these domains (robots would do it better anyway) but to master one’s emotions. Only few people are left to hold down part-time jobs particularly in activities which require human empathy, the last weak point of robots. The story is in fact ironic in the sense that it shows our admiration for machine qualities and our quest to become ourselves like machines.

## 4 Questions on Personal Robots

Personal robots have been characterized as robots which share physical and psychological spaces with humans. Alike PCs personal robots are multi-purpose single-user robots at home or at work deployed as toys, vacuum cleaners, lawn mowers, home security guards, caretakers, companions or artificial pets (figure 4.4). They shall enable humans to be more independent from handicaps and daily tasks, improve productivity, comfort and safety, and even establish emotional relationships.

Population aging is expected to be among the most prominent demographic trends of the 21st century. This is why one class of personal robots – assistive robots for the elderly and the impaired – might see a wide proliferation in a not-so-far future. In about 30 years elderly people above 60 will make up one third



**Figure 4.4.** Examples of commercialized personal robots (f.l.t.r.): Sony AIBO, Friendly Robotics Robomow, Robowatch MOSRO Mini, Omron Necoro, NEC PaPeRo, Electrolux Trilobite

of the population in developed countries (UN 2004b). The exact numbers vary by nation but show the same tendency. The cost for public health systems will increase and the ratio between the number of caretakers and persons in need of care will deteriorate. Robotic aids can bring down costs for the government and the patient and help elderly people to keep their independence over longer periods of time. Four projects exemplify the concept of a robot assistant: The project MOVAID from 1994 conducted as a EU research initiative led by SSSP, Pisa, Italy, the Care-O-Bot platform from IPA Stuttgart, Germany, the robot Pearl from CMU Pittsburgh, USA, and Wakamaru, the robot by Mitsubishi, Japan, first presented at Robodex 2003 (figure 4.5).

The group of questions on personal robots scrutinizes the acceptance of such robots, their appearance and the user's feeling of autonomy.



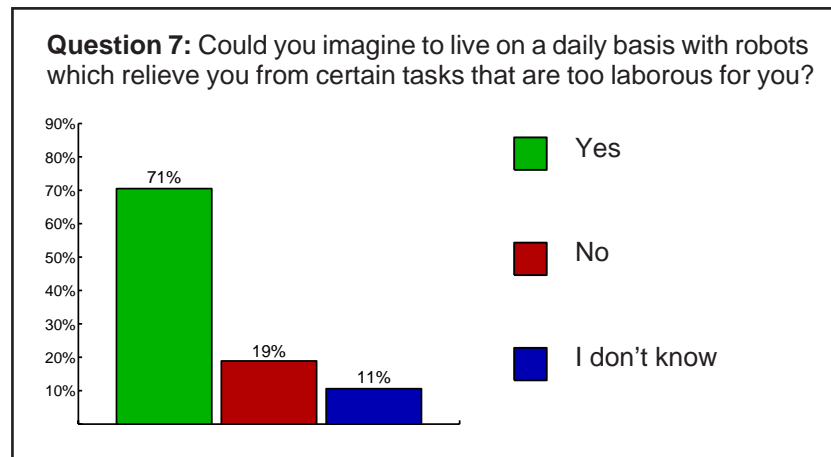
**Figure 4.5.** Four prototypes of assistive robots for the elderly: MOVAID, Care-O-Bot, Pearl, Wakamaru

## 4.1 Robots in Daily Life

The first question is “could you imagine to live on a daily basis with robots which relieve you from certain tasks that are too laborious for you?” with choices “yes”, “no” and “I don't know” (question 7).

A majority tends to accept this idea: 71% of the subjects said yes, 19% reject the robot and 11% are undecided.

Crossing these data with gender reveals a more positive attitude for men (79% yes, 13% no) than for women (62% yes, 26% no). The most well-inclined age group making up one fifth of the 71% yes-fraction are young adult between 20 and 35 years. Teenagers still contribute 12% and participants above 35 years show a decreasing acceptance the older they get. The most skeptical age group are elderly people above 65 years which make up only 6% of the yes-votes. We further find a high link to the happiness-question: 85% of the subjects who said yes to happiness through robotics said also yes to the robot in their daily life. Vice versa, 75% who said no to the robot (and only 45% who said yes) believe that robotics cannot contribute something to their personal happiness. We discuss these outcomes in the following subsection together with those of the next question.



## 4.2 Robot to Regain Independence

Question 8 aims at robots for the elderly and impaired: “suppose you cannot handle the tasks of daily life anymore (age, handicap), would you accept a robot to help you to partially regain your independence?” with response categories “yes”, “no” and “I don’t know”.

The answering behavior is very positive: 83% of the participants would welcome the robot, 6% reject it and 11% do not know.

Among those who accept the robot are 87% men versus 78% women while both groups are at 50% in their rejection of the robot. But women are not more negative, they are more uncertain: the 11% of subjects who are undecided consists in 15% women and 8% men. Regarding age there is a clear tendency: acceptance increases with age monotonically from 70% to 90%, that is, the older people get the more likely they accept the robot which assist them in case of a loss of independence.

Correlations with the happiness- and the welfare-question are high and even stronger than in the previous question: 92% of subjects who believe in happiness through robotics say yes to the robot and 90% of subjects who think that robotics might contribute to their welfare accept the robot to partially regain their independence.

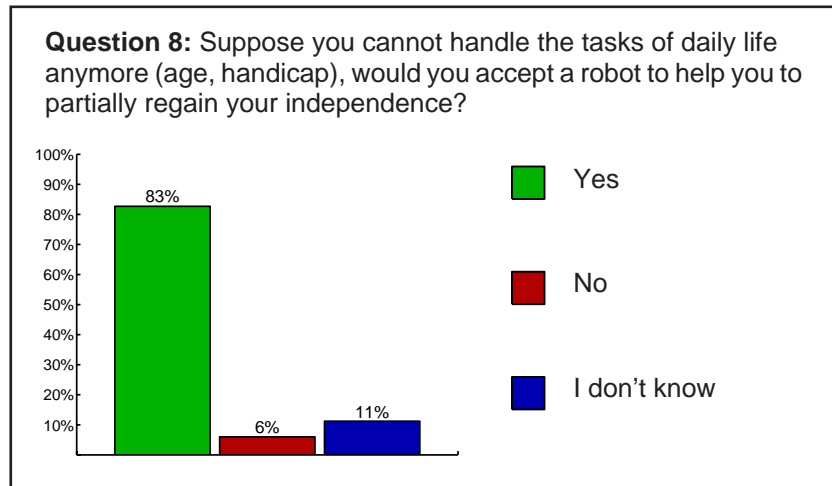
### 4.2.1 Discussion

With 71% yes-votes, personal robots seem to enjoy a high acceptance rate in general. It becomes even stronger in the situation of a loss of independence where 83% of the subjects would share their life with a robot if it helped them to partially overcome this loss. This is good news for the robotics community.

The responses reveal that the potential buyers for both types of personal robots are different. It seems that a sharp distinction is made between help and need. Many people who said no for the first one say that they do not know for the second one, and many people who said they did not know to the first one say yes to the second one. The most positive age group for question 7 are young adults. Possible reasons for this response behavior are:

- Young adults pursue a contemporary lifestyle which includes a high degree of home automation
- They go for the gadget character of robots
- They see the robot as a status symbol

On the other hand, elderly participants, the most skeptical age group for this robot, become the strongest advocate for the robot as an assistant for a person in need of care. They contribute also to the high correlation to the welfare- and happiness-question as in both cases they were the most inclined group to think that ro-



botics can contribute something to their personal welfare and happiness.

The positive attitude of men turns out to be a tangible tendency in all questions so far. It confirms stereotype pictures about technology and genders but comes as a surprise in such an extent. Women, traditionally in charge of housekeeping should have an even stronger interest in assistive technologies which help them to better fulfill their tasks. But this seems not to be the case. We conjecture about possible reasons:

- Women are less familiar with high-technology and robotics. Combining this with the finding that foreknowledge fosters acceptance (see related work section), they simply refuse to share their life with a technology they do not know.
- Women are more sensitive to the usefulness of technology than men. For them, robots still arouse a gadget-suspicion. The robotics community has not yet succeeded in disseminating the message of robots as valuable aids and companions to a wide public.
- Women who hold down a traditional role in the household consider robots an intrusion into their marked terrain.
- Switzerland is a country of classical role models. In a recently published study of the World Economic Forum which assesses the size of the so called gender gap, 58 countries are ranked according to the level of advancement of their female population<sup>1</sup> (*WEF 2005*). Switzerland performs poorly on rank 34 behind its neighbors Germany (rank 9) and France (rank 13). The ranking, headed by Sweden and the Scandinavian countries, lists the USA on rank 17 and Japan on rank 38. This gender-specific imparity amplifies the points just laid down.

### 4.3 Humanoid Appearance

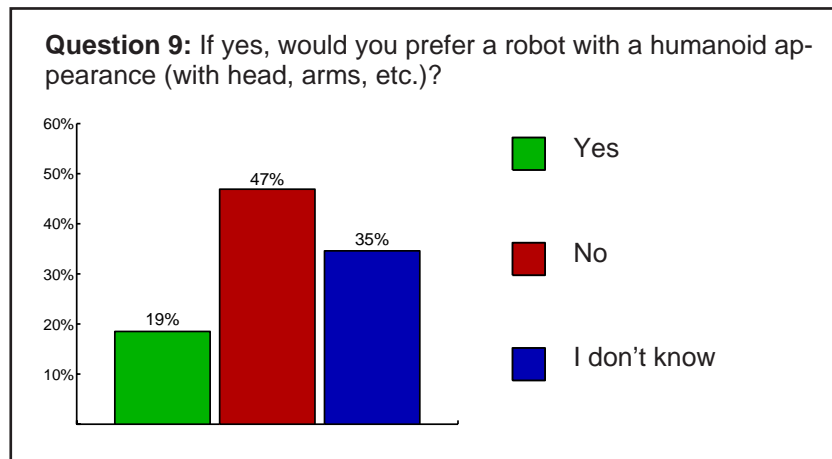
Conditioned on a positive answer to the previous point the next question is: “would you prefer a robot with a humanoid appearance (with head, arms, etc.)?” with choices “yes”, “no”, and “I don’t know” (question 9).

The current trend towards humanoid robots, spreading out mainly from Japan, is founded on the assumption that robots need to be human-like when they enter our physical and social space. It is true that a domestic robot must partially duplicate the human anatomy as a household is made for it. And it might be helpful for a social robot to connect with humans using their natural communication modalities.

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1. The study measures the extent to which women have achieved full equality with men in five areas: economic participation, economic opportunity, political empowerment, educational attainment, health and well-being relying on a number of hard data indicators from international organizations as well as qualitative information from the Forum’s own Executive Opinion Survey.





However, it is debatable to what extent robots in general and our future flat-mates in particular shall look like human beings. That the equation “the more humanlike the better” does not hold was first pointed out by Mori with the concept of the “Uncanny Valley”. It describes a non-linear relationship between emotional response and similarity to human appearance and movement (*Mori 1997*). The principle, derived from psychological experiments, states that as any non-human entity is made more humanlike in its appearance and motion the emotional response from a human being will become increasingly positive, until a point is reached at which the response suddenly becomes strongly repulsive. As the appearance and motion are made to be indistinguishable to that of human being, the emotional response becomes positive again and approaches human-human empathy levels. The conclusion drawn is that designers of robots or prosthetics should not strive overly hard to duplicate human appearance, but maintain a degree of visible artificiality. In other words, to balance function (what is the robot effectively able to do) and form (what expectations does it evoke). An example of such a design process is the robot from the MOVAID project (figure 4.5), a robot which is – alike Robox in figure 2.1 – mildly anthropomorphized yet visibly mechanistic.

The idea of a humanoid robot is not a desire by almost the majority: 47% answer with no, 19% with yes and 35% are undecided (question 9)

A deviation is statable for the questionnaire language: only 16% of the German-speaking participants voted yes versus 25% of the Francophone subjects. Accordingly 51% of the former group does not prefer a humanoid appearance versus 37% of their French-speaking compatriots. Both groups are similarly undecided: 33% of the German and 38% of the French-speaking fraction.

There is a monotonically decreasing acceptance of the humanoid appearance with age. The older people are the more they reject the idea. Starting at 29% for teenagers and kids below 18 years, acceptance drops to 10% for elderly people above 65 years. Against the trend for the gender groups which has just been stated, women are slightly more positive than men when it comes to a humanoid robot design: 21% versus 17%.

People widely ignored that question 9 was conditioned on a positive answer of the question before and marked question 9 regardless their response to question 8. It was therefore to be found out whether the fact to accept a robot influences the answering behavior: among those who embrace the idea of a robot, the distribution is 18% “yes”, 45% “no” and 37% “I don’t know” which is almost equal to the total distribution of 19% / 47% / 35%. Hence, the response behavior in the previous question can be ignored.

#### 4.3.1 Discussion

Against the current trend in robotics our subjects mainly reject the idea of a humanoid design. However we state a high degree of uncertainty (35% do not know) and an non-uniform answering behavior across language and age.

The weak acceptance by elderly people is possibly explained by the Christian ban to imitate God in his life-creating faculty. The increasing disapproval over age is a possible expression of the fact that the aged are more religious than younger generations. Or on the other hand, if we assume a decreasing popularity of Christian ideas among young people, the answer could be an expression of the religious background plays a role for the question of robot design.

More than 50% more French-speaking participants (25%) are ready to accept a humanoid robot compared to the German-speaking group (16%), the latter being even negative by the majority (51%). This confirms our previous observation that Francophone subjects were more positive in their answering behavior in all questions so far, partly with a significant deviation. Possible reasons for the extent of this deviation are:

- The language border which traverses Switzerland is more than just the boundary of two different languages like German and Dutch but the encounter of the two West-European cultural regions in the south and the north. The Latin south-western region with a mainly catholic tradition and the Germanic north-western part with a mainly protestant tradition mark not only a boundary of different mentalities but a boundary of different cultures<sup>1</sup>.
- A translation is always subject to slight variations in meaning. The German term “Wohlergehen” might have a tinily different connotation than “bien-être” in French and “welfare” in English. However, the words in question enjoys a relative consistent meaning across the languages which is why we do not think that this factor is dominant.

We have two hypotheses about the gender difference in this question. Women who are more negative than men in all other questions except this one might be less interested in the pure technological aspects and more receptive to the robot’s appearance. More sensitive to traditional family values, they think that a domestic robot should have a humanoid look rather than a physically new form. On the other hand, men fear robots when too humanoid. Knowing their inferiority on the level of physical strength and endurance, the rejection of a man-like robot could be the expression of a gender-specific Frankenstein complex – using the words of Isaac Asimov.

#### 4.4 Feeling of autonomy

The last question in this section is “still in the situation of a dependence in daily life: In which case would you feel more ‘autonomous’ ?” with answers “if assistance came from a human”, “if assistance came from a robot”, and “I don’t know” (question 10).

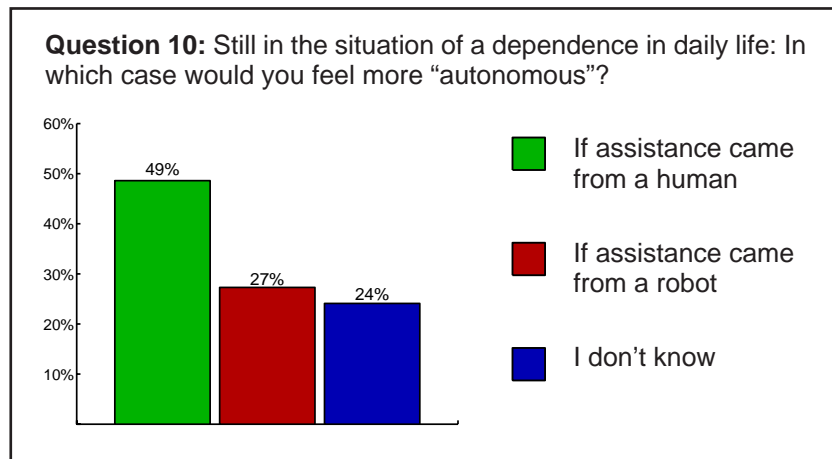
A majority of 49% feels more autonomous in case of assistance from a human, 27% in case of a robot and 24% of the subjects do not know.

While the French-speaking participants are almost uniform in their answers – 33% human, 37% robot, 30% undecided –, the German-speaking group goes more for human assistance: 55% human, 33% robot and 22% don’t know. Crossed with age we find a u-shaped distribution. Half of the teenagers below 18 years (49%) feels more autonomous in case of human help. For young adults between 18 and 35, answers start at 42% and find the maximum at 68% for elderly people of 65 years and above.

Crossing the data with those of question 8, the robot to regain independence, we find that 44% of subjects who accept the robot feel more autonomous if assistance comes from a human whereas 77% of subjects who reject the robot and 66% from the group which is uncertain have this feeling. Participants with a bad image of robotics (question 1) tend to have this feeling much more than those with a good image: 68% versus 39%.

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1. And indeed the result also confirms the clichés of the Swiss-Germans being more skeptical and head-driven whereas the Swiss-French are more impassioned and open-minded.



#### 4.4.1 Discussion

For the roboticist this outcome is a surprise. We rather consider machines as prolongations of the body which provide higher degrees of “social autonomy”, that is autonomy with respect to one’s social surrounding. Especially in the situation where care means intrusion into the patient’s privacy. But it appears that this reasoning does not apply for half (49%) of the participants while one quarter (24%) is uncertain about this point. For the anthropologist it is a surprise as well, but a good one. In a society where social links are becoming weaker every day, it is good to see that people do not appreciate being “socially autonomous”.

When breaking down those 49% we find from the correlations with the other questions that they are formed by participants who reject the robot to regain independence, are undecided about it, have a bad image of robotics or are advanced in age. We reason that the higher the acceptance of a robot in case of a loss of independence the weaker the feeling of autonomy if assistance comes from a human. In other words, the robot to regain independence is rejected of subjects who feel more autonomous with a human assistant.

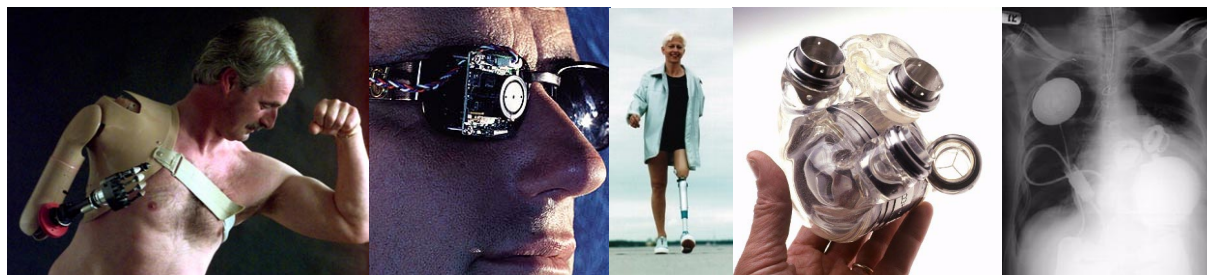
Let us take a look on the answering behavior of elderly people, the group which is already or most likely concerned by a loss of independence: why the highest rate of acceptance of a robot to regain independence when on the other hand they feel most autonomous in case of human help? We conclude that their notion of autonomy is a different one. Autonomy is not understood as being independent from one’s social surrounding (“social autonomy”) but as being more capable to fulfill the tasks of daily life which *includes* maintenance of social contacts. If this is true the response behavior in question 10 is the result of the fear that a robot care-giver will amplify the user’s social isolation.

Teenagers are the least autonomous group still enjoying the care of their parents and confirm the response behavior of elderly people. They are the second most positive group to prefer human assistance. For both groups we observe that the stronger the need for care the stronger the feeling of autonomy in case of human assistance.

## 5 Questions on Robotic Prostheses and Artificial Organs

Earliest artefacts of artificial limbs date back to Antiquity. The idea to employ robotic prostheses for this purpose is as old as the advent of real robots in the sixties. Early work includes the Stanford Rancho Arm from 1963 and Waseda Hand programme started in 1964.

Several ways exist to control robotic prostheses. Devices with a certain degree of autonomy measure and



**Figure 5.6.** Examples of exo- and endoprostheses (f.l.t.r.): Edinburgh Modular Arm System, Dobelle artificial vision system, C-Leg microprocessor-controlled knee, AbioCor artificial heart, x-ray of the AbioCor device implanted

adapt to the user's activity such as the C-Leg, a commercialized above-knee prosthesis which improves stability and walking comfort (*Otto Bock 2003*). There are myoelectrically controlled devices such as that Edinburgh Modular Arm System employed in 1998 as the first bionic arm (*Gow et al. 2001*). Small electric currents in the remaining musculature are measured, analyzed and transformed into motion commands. Another interface option are brain-computer interfaces which can read control commands directly from by thought. The announced BrainGate system of Cyberkinetics Inc. for instance consist of a sensor that is implanted on the motor cortex of the brain. The sensor signals are interpreted and translated into cursor movements on a PC which serves as a multi-purpose console for severely motor-impaired individuals (*Cyberkinetics 2004*).

The first electronic device to be implanted in a human body was the pacemaker in 1958. It was a hockey-puck sized device requiring an open heart operation. Today, implantation is minimally invasive routine surgery under local anesthesia. Opposed to pacemakers which save and improve life of millions, artificial hearts are still in a prototype stage. They replace the dysfunctional organ of patients with end-stage heart failure or bridge the time until a donor heart becomes available. While the first artificial heart, the Jarvik-7 from 1982, bound the patient to a washing machine-sized air compressor, the AbioCor from 2001 is completely implanted. Fourteen persons already received the AbioCor heart in a clinical trial program (*Abiomed 2004*). There is research on artificial replicas of kidneys, livers, lungs, skin or pancreas. At present the technology is still far from fully implantable devices and aims first at a usage as a bridge to natural organ transplantation.

On the front of sensory prostheses, the first person was implanted with a cochlear implant in 1978. Unlike hearing aids, cochlear implants can also be used by people with severe nerve damage. As of 2003, more than 50,000 people worldwide have received a cochlear implant. Approximately half are used by adults who have become deaf and half by children who were born deaf (*Bionic Ear Institute 2003*). Neuro-prostheses to restore eyesight to the blind is another active field of research. Bypassing the need to have intact retinas entirely, the Dobelle artificial vision system consists of a miniature video camera, a signal processor, and a brain implant. The picture from the eyeglass-mounted camera is transformed and fed into the brain (*Kotler 2002*). Other approaches use retinal prostheses that require a part of the retinal cells to be still healthy.

Chip implants open up a number of new applications such as wireless biometrical data exchange with an external infrastructure. A pioneer in this field is Kevin Warwick from the University of Reading, UK, who in 1998 had a chip implanted that enabled him to exchange information with the University department building. A computer could monitor him as he moved through halls and offices. He could operate doors, lights, heaters and other computers. In a second experiment in 2002 a one hundred electrode array was surgically implanted into the median nerve fibres of his left arm. It enabled him to control a wheel chair and an artificial hand. The array was also able to create stimulation which was demonstrated with a neural implant in Warwick's wife. They could "exchange" sensations (*Warwick et al. 2004*).

In April 2004 the Baja Beach Club in Barcelona offered to implant a subdermal chip under the skin of its VIP clients. The rice-grain-sized chip not only guaranteed entry but provided access to a debit account from which they can pay for drinks. The offer was also extended to a nightclub in Rotterdam and Glasgow (*Martin 2005*). Over 100 persons got “chipped” so far. According to the owner of the beach club, many people are willing to be implanted, most of them already have piercings, tattoos or silicone. The chip is commercialized by the US-based company VeriChip and was also implanted into a Mexican Attorney General and a number of his staff in order them to be traced if they are abducted (*Wired 2004*). Other applications of chip implants include monitoring health parameters of chronically ill patients. In a trial programme to begin by Christmas 2005 at St Mary’s hospital, London, a sensor chip shall be implanted in diabetics. It detects tiny changes in metabolism and transmits data, via a mobile phone, to the patient’s doctor<sup>1</sup> (*Carr-Brown 2005*).

This group of question addresses the issues of different types of prostheses, artificial organs and implants.

### 5.1 Conventional, Robotic and Robotic Neuro-Prosthesis

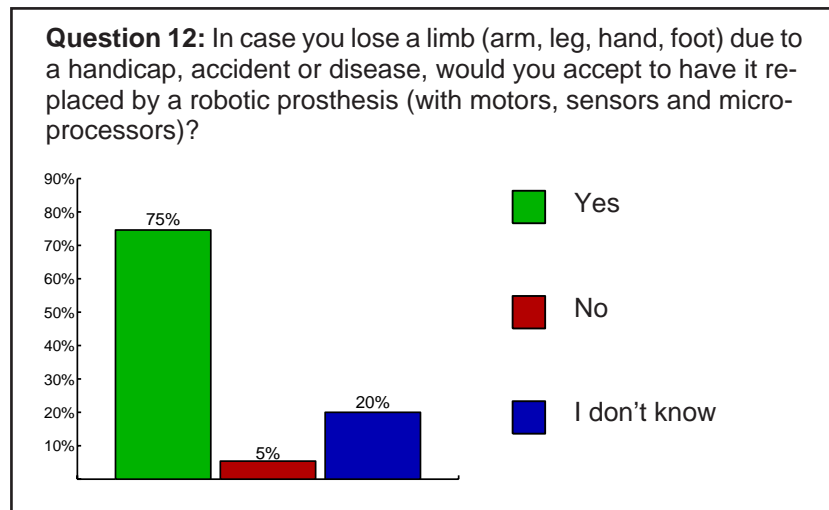
The first three questions make up a subgroup, first aiming at conventional prostheses: “in case you lose a limb (arm, leg, hand, foot) due to a handicap, accident or disease, would you accept to have it replaced by a conventional prosthesis?” with answers “yes”, “no” and “I don’t know” (question 11). The next question introduces the robotic prosthesis: “in case you lose 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)?” (question 12). And finally: “still in the same situation, would you accept to have it replaced by a prosthesis directly connected with and controllable by your nervous system?” (question 13).

The conventional prosthesis would be accepted by 69% of the participants and rejected by 7% while 24% are undecided. 75% of the subjects answered yes for the robotic prosthesis, 5% reject the robotic limb and 20% did not know. For the robotic neuro-prostheses accordance was 61%, rejection 11% while 28% did not know.

Crossing the data from questions 11 and 12 reveals that subjects have changed sides. The increase of 6% yes-answers in question 12 does not proportionally come from undecided or negative subjects in question 11. Three fourth (77%) from the group which was against a conventional prosthesis and one half (51%) from the undecided group in question 11 say yes to the robotic prosthesis. Accordingly, the “no”-



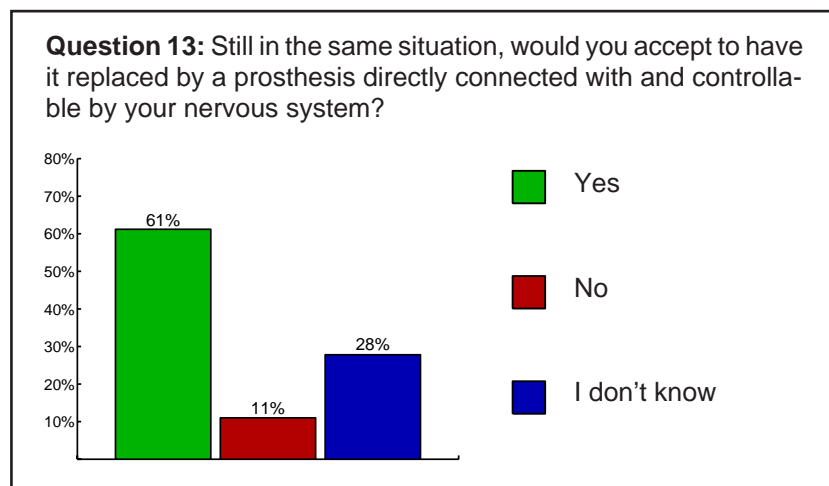
1. The sensor includes a Pentium microprocessor just 2 mm square. Intel Inside.



group in question 12 changed, consisting now of 60% subjects which accepted the conventional prosthesis in question 11.

Regarding gender and language for the conventional prosthesis we find higher acceptance rates among men (71%) versus women (67%) and Francophone (81%) versus German-speaking subjects (64%). For question 12 (robotic prosthesis), a similar answering behavior can be stated: men accept the robotic limb to 80% versus 67% women and French-speaking subjects to 80% versus 72% of the German-speaking group. The robotic prosthesis has a higher acceptance rate among elderly people: from 58% of subjects younger than 18 years, acceptance increases to 86% of participants between 56 and 65 years. There is a slight decrease to 77% of people above 65 years. This changes for the robotic neuro-prosthesis (question 13): the most positive age group are young adults between 19 and 35 years with 20% acceptance. This diminishes monotonically to 6% for elderly people above 65 years while teenagers and kids below 18 years accept it with 11%. Men and French-speaking participants are more positive again: 69% men accept the neuro-prosthesis versus 51% women and 69% French-speaking subjects are positive versus 58% of their German-speaking compatriots.

Crossed with question 7, the robot in daily life, and question 8, the robot to partially regain independence, we find that the more subjects accept the robots the more they accept the prostheses, particularly for the robotic prosthesis and the robotic neuro-prosthesis. Zero correlation would be the case where the subjects who accept the prostheses would come from the “yes”- and the “no”-groups in questions 7 and 8 to equal



parts. But in question 12 they come to 88% from the positive and to 50% from the negative group in question 8. Vice versa, 89% of participants who say yes to the robotic prosthesis have said yes to the robot to regain independence while 47% who say no to it have said yes to the robot. For question 13, the neuro-prosthesis, we find a similar deviation: subjects who accept the prosthesis come to 67% from the positive and to 38% from the negative group in question 8. Conversely, 90% of participants who accept the robotic neuro-prosthesis have said yes to the robot to regain independence while 63% who reject the prosthesis have said yes to the robot. The numbers for question 7, the robot in daily life, are very similar.

### 5.1.1 Discussion

People who accept the idea of a conventional prosthesis are not those who accept a robotic prosthesis. The crossing results show that those who welcome a robot at their side seem to be open to the idea of a robotic or a robotic neuro-prosthesis which is not a surprise. The others tend to prefer a traditional prosthesis. In any case, the neuro-prosthesis is less welcomed than the “simple” robotic prosthesis. Even people who would accept robots in their everyday life hesitate.

Acceptance decreases if the nervous system is involved. We assume that this is related to the concept of humanity, the ensemble of faculties from which we think constitutes us as humans and separates us from machines (see also questions 4 and 5). This property is generally located in our brain and more broadly in our nervous system. Even if we consider ourselves as imperfect and strive for technological enhancements for our limitations, humanity is considered very important. A prosthesis connected to the nervous system might feel like a threat for a part which is that central to us.

## 5.2 Artificial Organ

Questions 14 and 15 aim at artificial organs in two different situations. The first question is “in case of disease or injury, and if your *life* would depend on it, would you accept an artificial organ to replace your disabled organ?” with answers “yes”, “no”, and “I don’t know” (question 14). The second question varies the situation: “in case of disease or injury, and if your *quality of life* would depend on it, would you accept an artificial organ to replace your disabled organ?” (question 15).

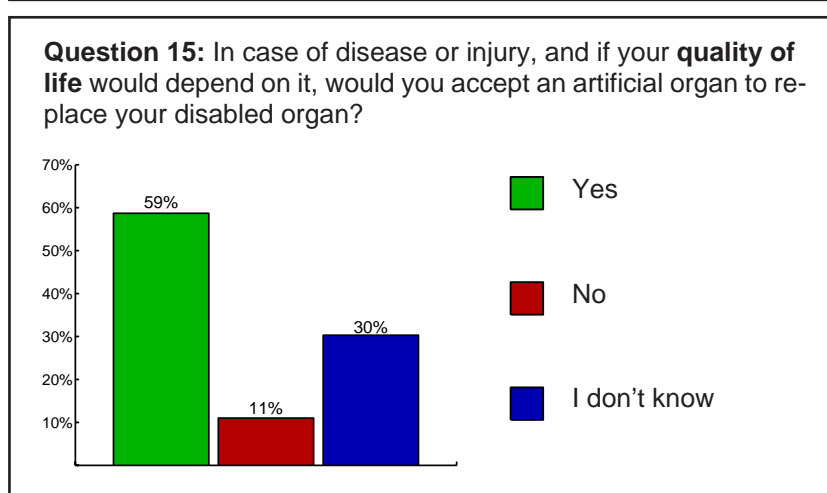
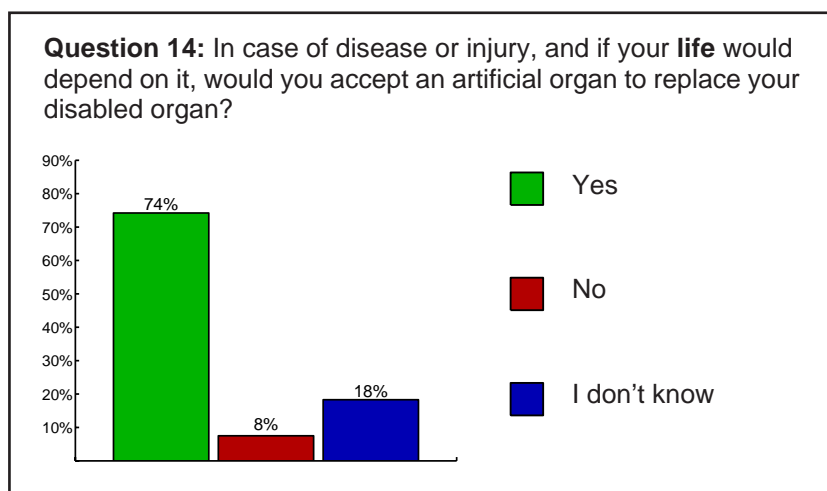
74% of the subjects would accept an artificial organ if their life depended on it, 8% would reject it and 18% are undecided. In the quality-of-life situation acceptance drops to 59% versus an increase to 11% rejection while 30% of the subjects are undecided.

We find the trend for language and gender confirmed again: 81% of the French-speaking subjects accept the artificial organ of their life depended on it versus 71% German-speaking participants. Men accept the organ to 79% versus 69% women. For the artificial organ to increase quality of life, acceptance rates are 69% for the French-speaking group versus 53% for the German-speaking group and 63% men versus 53% women.

The age distributions of the two questions differ: the most positive age group for the artificial organ to stay alive are young adults between 18 and 25 years (80%) followed by teenagers below 18 years (71%). For subjects older than 25 years acceptance diminishes monotonically. The least positive group are elderly people above 65 years with 64%. On the contrary, in the case of the artificial organ which provides quality of life, willingness to share one’s body with that organ increases with age monotonically from 52% to 63%.

### 5.2.1 Discussion

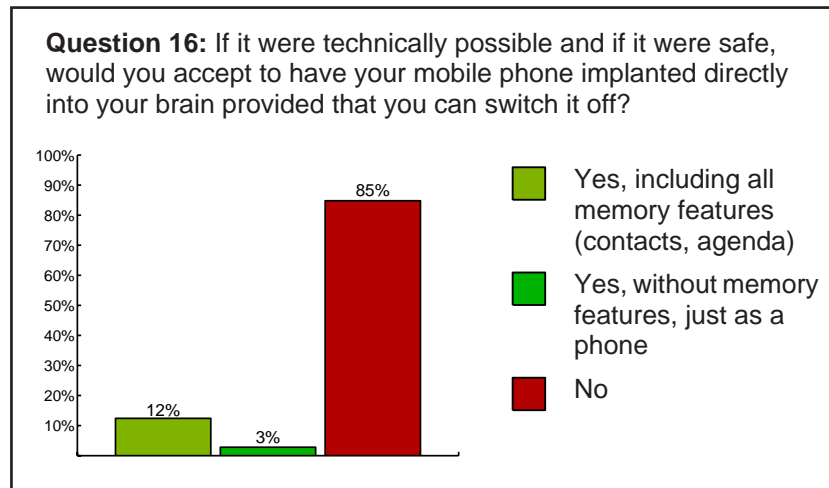
The high acceptance rates suggest that a clear majority of subjects takes for granted that an artificial organ can perfectly replace a natural one, even if people are more willing to accept the implant when they need to save their lives than for quality of life.



The response behavior of teenagers and elderly people is understandable. Teenagers feel least concerned by problems of quality of life. As they are young, most of them are healthy and a loss of quality of life is something very theoretical. In view of the years ahead, however, the artificial organ to save their life is much more appreciated. Elderly people are most negative for this organ but the most positive group to accept the organ for quality of life. It appears that quality of life is what they prefer for the years which remain but not at all costs. The organ which “just” saves life might also evoke the image of the bedridden patient who is indeed alive but has lost any quality of life. This illustrates that the concept of quality of life is stronger and contains life.

Let us try to explain the language difference. Tetsuwan Atomu (Astroboy) is a post-war creation from 1951 by Osamu Tezuka, a famous Japanese comics illustrator. Still today the goodhearted robot boy enjoys a wide popularity and, when asked, many Japanese researchers refer to him as an important personal inspiration but also as a prominent influence for the status of robotics in Japan. When assuming that elements of the popular culture can sustainably influence people’s attitude to a technology we cannot ignore that in the Francophone space there is a lively comics culture contrasted by nothing comparable in the Germanic space. An important sub-genre therein are science-fiction stories (from authors such as Jodorowsky/Gimenez) full of cyborgs, androids and odd fusions of man and machine. Alike Astroboy in Japan, this comics culture might partially explain the positive response behavior of the French-speaking subjects in this group of questions.





### 5.3 Cell Phone Implant

The last question brings technology even closer: “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?”. Possible answers are “yes, including all memory features (contacts, agenda)”, “yes, without memory features, just as a phone”, and “no” (question 16). The two different positive answers allow to see whether people are sensitive to the distinction between an extension of their abilities (by the calling function) or an extension of their memory (by the artificial memory).

The question is not as far-fetched as it seems. In June 2002 a prototype of an audio tooth implant that serves as a cell phone has been unveiled by two British inventors from the European Media Lab (*Sandhana 2002*). Sounds are transferred from the tooth into the inner ear by bone resonance. A totally discreet sound reception is the result. Phonak Inc. a Swiss-based producer of hearing aids released recently the Smartlinx SX, a behind-the-ear hearing instrument for individuals with a hearing loss. Via Bluetooth it directs incoming calls to the carrier’s cell phone automatically to the hearing instrument (*Phonak 2004*). It takes just one step from here to provide this functionality to cochlear implants in order question 16 to become reality at least for people with such implants.

Participants mostly reject the brain implant: 12% of the subjects accept the cell phone including all memory features, 3% accept it without memory features and a majority of 85% reject the idea.

Taking the two positive answers together – resulting in 15% acceptance –, twice as many men prefer the implant: 20% versus 10% women. For age we find an u-shaped distribution: the most positive group with 27% are teenagers below 18 years. Acceptance varies between 10% and 13% for adults between 18 and 54 years as the most negative group. Acceptance goes up again to 19% for elderly people above 55 years. There is no difference across the language groups.

Considering people with a good image of robotics, we find 24% accepting the idea of the phone implant opposed to 12% of subjects with a neutral image and 7% of those with a bad image.

#### 5.3.1 Discussion

One might think that 15% acceptance of such a device is a surprisingly high percentage but the answers show also that the limit is here. It appears as the last step, the most intrusive one, is only welcomed by those participants who have a general good acceptance of all other technologies considered so far. The crossing results show that subjects who accept the phone implant accept almost all the other technologies but the con-

trary is not true: subjects accepting other technologies do not necessarily accept the phone implant.

A comparison with the artificial organ to provide quality of life is noteworthy. 80% of those who accept the phone implant accept the organ for quality of life but only 17% of those who accept this organ accept the phone implant. In other words, a cell phone implant is not considered as an improvement of one's quality of life, contrary to what many advocates of implant technologies say.

Teenagers and kids seem to be the most open minded group for this kind of ideas: it is the only question where teenagers are the most positive age group and it was the most futuristic scenario. Children grow up today in a cultural context with fictional and real cyborgs. From the family's wall-mounted telephone to the personalized cell phone, they see technology coming closer, getting more personal and intrusive. Implantation is just the last step of this development (*Cerqui and Arras 2003*). These might be the reasons why it is easier for them to imagine this ultimate fusion.

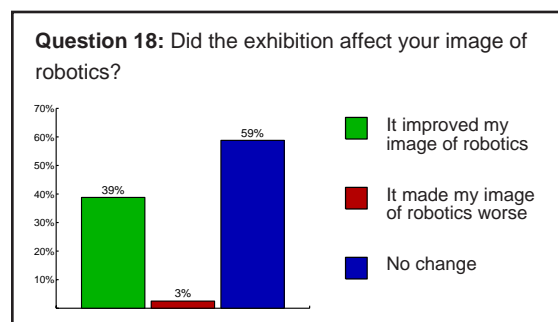
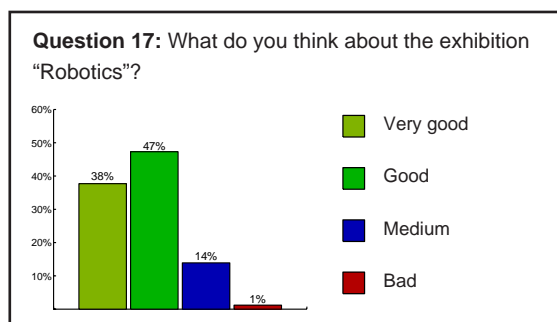
Among the subjects who accept the implant, a clear majority accepts it with the memory features included. Considering our current social values, with the importance given to brain and mind, we expected the subjects to be more skeptical of a computer memory connected with their brain. But it seems not to frighten them: why renouncing useful features if the effort to receive an implant is made anyway? Considering that the most positive group which accepts the phone implant is very young, we can assume that this group is one step further in the perception of technology as an extension which can even improve our brain abilities. And to speak with the words of section 3.3 (human and robot qualities), a technology which helps us to complete ourselves with the "cold" qualities.

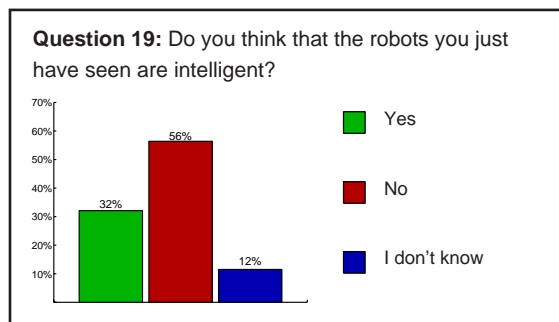
## 6 Questions on the Exhibition

This section contains questions which are specific for the "Robotics" exhibition. The first one is fairly general: "what do you think about the exhibition 'Robotics'?" with four choices: "very good", "good", "medium" and "bad" (question 17). The answers testify a mainly positive feedback with 38% very good, 47% good, 14% medium and 1% bad. This makes up 83% of the visitors who thought that the exhibition is either good or very good.

The next question is "did the exhibition affect your image of robotics?" with the answers "it improved my image of robotics", "it made my image of robotics worse" and "no change" (question 19). For a majority of 59% there was no change, for 39% of the subjects the exhibition improved their image of robotics and for 3% the exhibition made it worse.

And finally: "Do you think that the robots you just have seen are intelligent?" with choices "yes", "no" and "I don't know" (question 19). A group of 32% thought that the robots were intelligent, a majority of 56% rejected this idea and 12% did not know whether Robox is intelligent or not.





Crossing these results with those of the image-question, we observe that 59% of those who said that robotics is neutral say also that the robots they have seen are not intelligent. Vice versa, 74% of those who said that they are not intelligent say as well that robotics is neutral.

## 6.1 Discussion

In comparison to results from three other exhibitions at Expo.02 where surveys have been conducted, “Robotics” comes off as the winner in terms of positive visitor feedback. There are no results available from the remaining 33 exhibitions. Although the exhibition was well received it did not affect people’s image of robotics by the majority (59%). The group of 39% subjects which left the exhibition with a better image of robotics can be seen as consistent with (*Hammel et al. 1989*), (*Dario et al. 1999*) and (*Johnson et al. 2003*) where the subjects became more positive in their attitude towards a robotic aid as soon as they had more information.

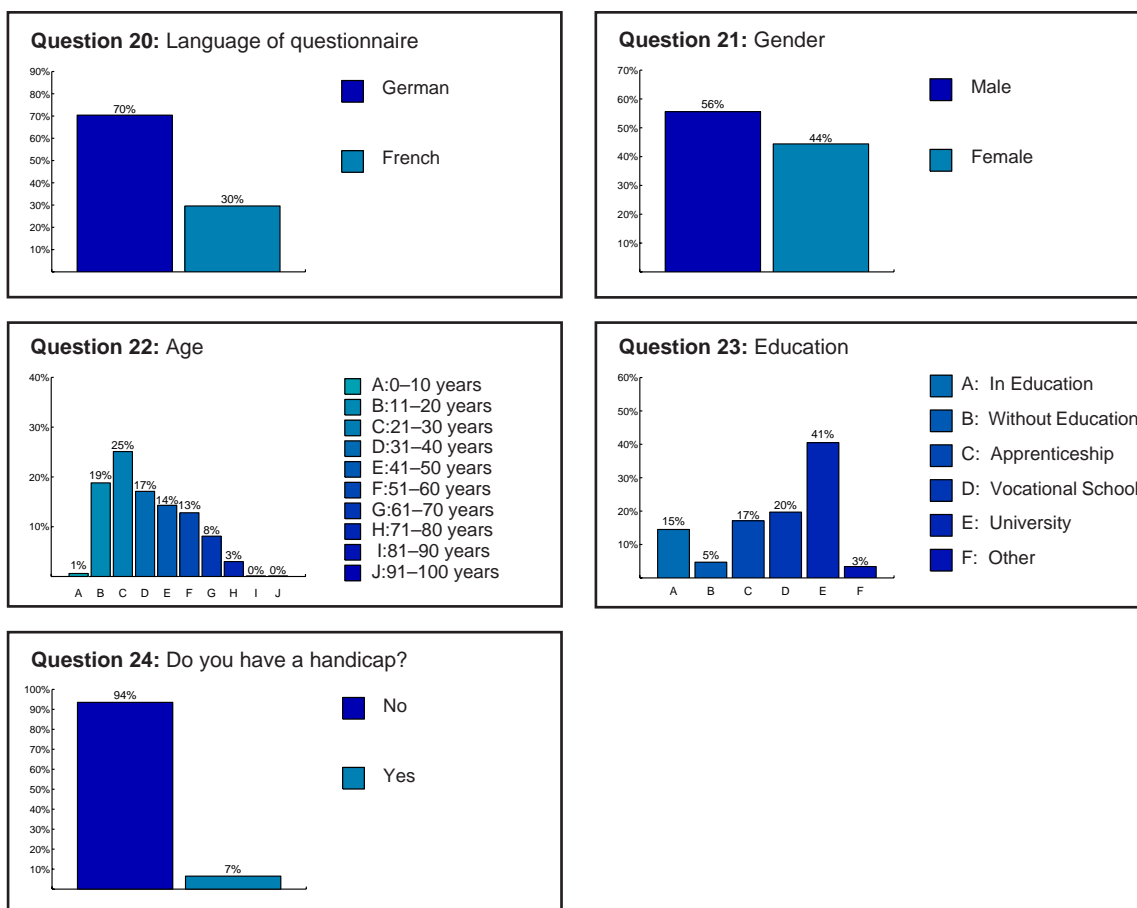
The majority’s opinion that our robots were not intelligent gives space for a number of interpretations. First, it is consistent with the answers from question 5 where robots are seen pragmatically as machines with attributes precision, reliability, rationality and perfection. When put in front of a yes/no-choice 56% reject the idea of robots being intelligent. When the participants had a choice with other qualities, only 26% chose intelligent, which means that when this faculty is in competition with others, it becomes spontaneously less relevant in people’s eyes.

In particular we must ask to what extent *Robox*, the exhibition robots, gave rise to this attitude. Although the robots fulfilled their tasks as tour-guides, photographers and entertainers very well (see the literature in the context section), the circumstances of a mass exhibition made their job not an easy one: when 120 curious persons of all ages (which is an average number of visitors in the pavilion at the same time) encounter eleven robots, pressing buttons, blocking paths and trying to discover their limits, the robots do not look excessively intelligent all the time. For example, interactivity had been deliberately limited in order for the robots to terminate their tours, travel speed was limited to 0.4 m/s for safety reasons (which made them look “slow” sometimes), and, as mentioned, the scenography intended to exhibit today robotics “as is” without particular pretension of (present or future) machine intelligence.

## 7 Participant Data

This section contains the participants data and compares it with the Swiss averages from the federal office of statistics. We will see to what extent the 2042 subject were a representative sample, and if no, where they deviated from the average.

For the questionnaire language, we counted 70% German-speaking and 30% French-speaking participants (question 20). The official numbers are 63.6% versus 20.3%. The difference to 100% are citizen with



other mother tongues, mainly the two other national languages Italian and Romansh. As it is unknown whether those groups preferred the German or the French questionnaire we cannot find exact numbers but believe that there is a small bias towards more German-speaking subjects.

The sample is unbalanced regarding gender with 56% male and 44% female subjects, the Swiss averages being 48.9% men and 51.1% women (question 21).

For the age distribution, the official statistics counts 22.3% people under 20 years, 28.1% between 20 and 39 years, 33.9% between 40 and 64 years and 15.7% for elderly people above 65 years. The sample is therefore roughly representative for teenagers, kids and adults between 40 and 64 years while elderly people above 65 years are underrepresented in favor of young adults between 20 and 39 years (question 22).

The education levels have been asked in question 23. Response categories were “no education” (5%), “in education” (15%), “apprenticeship” (17%), “vocational school” (20%), “university” (41%) and “other” (3%). The official statistics are as follows: 19% Swiss have no education (obligatory school), 47% made an apprenticeship, 10% finished a vocational school and 18% have university or university-like grade. Hence, the sample contains a lot more subjects with higher education levels (university and vocational school) whereas lower educations are underrepresented.

For the handicap question (question 24) there are no comparable data to our knowledge. Also because the question was vaguely posed and did not distinguish between different types of handicaps (mental, physical).

## 8 Conclusions

This section summarizes responses, draws conclusions and makes suggestions for future research directions derived from the findings obtained. Three user profiles are highlighted: women, elderly people, and the French-speaking group. We further address two issues with surprising results, the humanoid design problem and the tool/companion relationship of robots. Finally, the role of the survey's context is discussed.

### 8.1 Women

Exposing themselves as the skeptical gender group, women seem much less willing to accept robot technologies in their life than men. Their response behavior is more negative in all questions except question 9, where they were slightly more positive for a humanlike robot with 21% versus 17%.

Since the word has been coined by Capek in 1920, the film *Metropolis*, the stories of Asimov, the first famous robots Gort, Robby and Astroboy in the fifties, and at the latest since R2-D2 and 3-CPO, the two secret stars from the *Star Wars* trilogy in the seventies, robots are a part of our popular culture. But we need no survey to state that they populate the fantasies of men and boys more than of women and girls. At the same time, real robots were developed, produced, and applied typically be men. In front of this background we cannot expect that a recent development like the rise of a new generation of robots for domestic applications changes the public opinion within the short time of a few years. The response behavior of women simply show that robotics is still a male world.

Thus, the responses uncover a place where robotics requires promotion on the way to one of the “most powerful 21st-century technologies” (*Joy 2000*). If we assume the equation “women = household” – which seems more true for certain countries than for others according to (*WEF 2005*) – and if we succeed in making these women understand that a robot is a true help in fulfilling their domestic task, we evoke an immense economic power far beyond the markets for sci-fi product, toys and gadgets. Ergo – and loosely speaking – we should not only go for the customers who read *Linux* magazines and watch *Star Trek* but also for those who read fashion magazines and watch the daily afternoon soap. And if it is true that women are more down to earth if it comes to the usefulness of a technology, this aspect should always stay in the center of attention.

Research programmes which focus on the development of robots made for women and which question how a robot receives this property are worth to be considered last but not least to encourage more female students and researchers to join the field.

### 8.2 Elderly People

The answering behavior of elderly people is marked by many extremes. Among all age groups elderly people have the best image of robotics and are the most inclined to believe that robotics can contribute something to their personal happiness. They are least willing to share their life with a robot which just liberates them from certain tasks but are the most positive group for a robot to regain independence in the situation where they can no longer fulfill the daily tasks. They further feel most autonomous when they receive assistance from a human helper opposed to a robotic aid and reject the neuro-prosthesis at most. In the case of artificial organs which saves their life, elderly people are the most negative group but the most positive one when it comes to the artificial organ to improve their quality of life.

We can state a general skepticism of elderly people towards new technologies but at the same time a high sensitiveness to the issue of quality of life. The responses show that the quest for quality of life is stronger: provided that a technology helps to improve it, elderly people are ready to overcome their skepticism.

From question 10 we conclude that elderly people reject the concept of “autonomy = home alone with a

robot”. The reaction can mean that they do not want to depend on technology but also that they worry to be lonely and socially isolated – a problem of elderly people in many western societies. Preferring human help can simply be the sign that they see the important task of maintaining social contacts questioned by a robot. If we want robot care-givers to be accepted we should strive for usage scenarios that neither reduce quantity nor quality of social contacts, provide functionalities which *support* social activities and make sure that they are not sold under the promise of higher degrees of “social autonomy”. A misunderstanding of the term “autonomy” or “independence” could be fatal for the acceptance of robots in care-applications by users, their families and human care-givers.

### 8.3 French-Speaking Group

That a different cultural background produces different societal attitudes towards robotics can be seen from the two “robotics cultures” in the East and the West. But it might be unexpected to see such a deviation across a language border in the same country. Throughout all questions, the French-speaking participants are clearly more willing to live with robot technologies than their German-speaking compatriots. In section 4.3.1 two possible explications for the behavior are given, one which highlights the existence of a deeper cultural boundary and a second one which considers artefacts introduced by the translation which were however assumed to be small.

A potential consequence from this outcome for future robots is the requirement of what is known as “product localization”. Product localization is the process of adapting a product to meet the cultural expectations of a specific local market. For many goods such as cell phones or cars it is proven to be vital for their success in a target market. But if for a cell phone which we consider a tool product localization is already that important, what about an robot companion which is part of the owner’s social and emotional space? We will probably be forced to respect local nuances in mentality and culture much more than for ordinary consumer goods. The issue of “localizing” a robot (in this sense) could become an key requirement to its design.

### 8.4 Humanoid Design

The result from question 9 is not a direct validation of Mori’s Uncanny Valley but it impressively confirms the need to think twice about the issue of robot design. The fact that only 19% of the subjects preferred a humanlike appearance is not a confirmation of the humanoid design paradigm. That the problem is not easy becomes also clear as robots enter a complex interplay of projections, perceptions and expectations on the part of the human observer when they look and behave humanlike.

We read the responses as a motivation to pursue alternatives to a humanlike appearance. We believe that a bold yet careful search in the vast design pool of unseen forms will give robots a credibility which would be appreciated by their human counterparts. Unconstrained by archetypes from biology, these new forms should underline the peculiarity of being a robot also beyond zoomorphic approaches. A robot is a robot. It is not a human nor is it an animal.

### 8.5 Robot Qualities

The outcome of question 4 (robot qualities) seems to contradict the vision that robots “may herald the first stages where people stop perceiving machines as simply tools” (*Duffy 2003*). The result raises the issue of the robot as a tool versus a companion. We take for granted that robots which once play a part in our daily life shall possess advanced interactive skills. This is certainly true for tasks which include a high level of corporation between the robot and the user. But for all other tasks, do people who describe robots pragmatically as perfect, reliable, rational and precise really want to share their “social and emotional space” with them?

A vague answer to the question of the robot's true utility at people's home can never be obscured by super-interactive skills if we want a sustainable impact of our technology. We read this outcome as a reminder to put as much effort on "workmanship" as on "companionship".

## 9 The Role of the Context

A major national event with 4.2 millions visitors is a very good background for any survey and a sample of 2042 subjects is considered large. However, as the participants data in section 7 show, this survey is not representative in a strict statistical sense. To remind, a method to obtain a representative sample is picking subjects randomly from a telephone book ("random sampling") or better, picking subjects randomly from so called strata, subsets of the population that share at least one common characteristics and whose sizes reflect the actual representation in the population ("stratified sampling").

As mentioned in section 2, visitors at Expo.02 rarely went to see all 37 exhibitions which means that a choice had to be made. The data show that "Robotics" was preferred by younger people, people with higher education, and by men more than by women. We believe that the choice – maybe influenced by a certain foreknowledge or interest – is likely to have injected a bias towards a more positive response behavior. However, with the sampling method used here ("convenience sampling") and the "Robotics" exhibition as the context one gets an approximation of the truth. We argue that this approximation is a good one:

- The exhibition was mostly visited by families and small groups. It is very unlikely that all members of such groups share the abovementioned motives to visit a robotics exhibition. For those who do not, the bias-assumption does not apply.
- Even with a bias towards more positive responses, there is no reason to assume that the behavior of individual groups is affected. Why should, for example, French-speaking subjects respond disproportionately different with respect to this bias? Therefore we believe that the crossing results hold.
- Unlike museum exhibitions where long visit durations allow for a profound insight into a topic, mass exhibitions are much more superficial as the average visit duration is between 15 and 20 minutes. This is an ideal background for a survey because subjects become contextualized without acquiring profound knowledge.
- The makers deliberately chose a neutral way how robotics was portrayed in this exhibition. The subject was presented such that the nowadays capabilities were emphasized without denying its limitations. Neither black nor bright future predictions were given.

To summarize, the study is representative for the portion of the population which matches the profile of our visitors. When inferring to the entire population, we have to keep in mind that the results have an approximative character.

## 10 Outlook

Two directions from here are worth to be explored. First, to repeat this survey in other geographical regions such as Asia, the United States or in other European countries. Provided that the context is similar and methodology and questions are the same, the data could be combined putting the discussion on a broader basis. A comparison of the results would be very insightful and stronger conclusions could be drawn.

Second, according to section 9, future surveys should be conducted to be statistically representative. Surveys are an integral part of social science and a number of sound sampling methods exist. This would be

connected with higher costs involved but would yield an even better approximation of the public opinion.

Finally we suggest questions not included in the questionnaire.

- A so called screening question, that is a question which asks for the foreknowledge, could be included in future questionnaires: “How much do you know about robotics?” with several categories ranging from “nothing” to “expert”. Motivated by the observation in previous work that foreknowledge has a large impact on the responses (see the related work section), the question would also allow to extrapolate over larger parts of the population especially when the sampling method is not representative
- To query the religious background could reveal interesting correlations to the general attitude or the humanoid design questions in particular. Response categories should contain the world religions (e.g. Christianity or Buddhism) including their major branches (e.g. catholic or protestant).
- Instead of guessing what future robots could actually do for us, the question could be posed directly: “If it were technically possible to build a robot which is able to do any task equally well than a human, what would the robot of your dreams do for you?”. A text open-end answer could uncover hidden user wishes but is more difficult to analyze. Otherwise a range of predefined choices could be given such as “to go to work for me”, “do my household”, or “love services”, possibly including an text open-end category “other”.

We strongly suggest to conduct surveys with a sufficient number of participants. Cross analysis with variables that are strongly unbalanced leads quickly to groups with very small numbers of subjects. This was the case with the handicap question (question 24, section 7) which yielded only statistically unreliable results. Adopting a conservative attitude they had to be ignored.

## Acknowledgements

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## Appendix A: German Questionnaire

Faculté des Sciences et Techniques de l'Ingénieur Institut d'Ingénierie des Systèmes  ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE	 UNIVERSITÉ DE LAUSANNE Faculté des Sciences Sociales et Politiques Institut d'Anthropologie et Sociologie	<b>Fragebogen</b> No.: <input style="width: 40px;" type="text"/> – D
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### Bitte Zutreffendes ankreuzen.

- 1) Welches Bild haben Sie von der Robotik ?
  - Ein gutes Bild: sie hilft den Menschen, ist für sein Wohl da
  - Ein schlechtes Bild: sie stellt eine Gefahr dar, nimmt den Platz des Menschen ein
  - Ein neutrales Bild: es hängt davon ab, was man damit macht
  
- 2) Hat die Ausstellung 'Robotics' ihr Bild der Robotik beeinflusst ?
  - Sie hat mein Bild verbessert
  - Sie hat mein Bild verschlechtert
  - Keine Änderung
  
- 3) Wie beurteilen Sie die Ausstellung 'Robotics' ?
  - Sehr gut
  - Gut
  - Mittelmässig
  - Schlecht
  
- 4) Könnten Sie sich vorstellen, im Alltag mit Robotern zusammenzuleben, die Ihnen gewisse Aufgaben abnehmen, die für Sie mühsam sind ?
  - Ja
  - Nein
  - Ich weiss nicht
  
- 5) Angenommen Sie könnten die Aufgaben des täglichen Lebens nicht mehr alleine wahrnehmen (hohes Alter, Behinderung), würden Sie einen Roboter akzeptieren, der Ihnen hilft, Ihre Unabhängigkeit teilweise wiederzugewinnen ?
  - Ja
  - Nein
  - Ich weiss nicht
  
- 5.1) Falls ja, würden Sie einen Roboter mit menschenähnlichem Aussehen vorziehen ?
  - Ja
  - Nein
  - Das ist mir egal
  
- 6) Immer noch in der Situation einer Abhängigkeit im Alltag: In welchem Falle würden Sie sich "autonomer" fühlen?
  - Wenn die Hilfe von einem Menschen kommt
  - Wenn die Hilfe von einem Roboter kommt
  - Ich weiss nicht

- 7) Glauben Sie, dass die Robotik etwas zu Ihrem persönlichen Glück beitragen kann ?
- Ja
  - Nein
  - Ich weiss nicht
- 8) Glauben Sie, dass die Robotik etwas zu Ihrem persönlichen Wohlergehen beitragen kann ?
- Ja
  - Nein
  - Ich weiss nicht
- 9) Stellen Sie sich eine Gesellschaft der Zukunft vor, in der die Roboter alle nötige Arbeit verrichten. Die Menschen bräuchten nicht zur Arbeit zu gehen. Welche Tätigkeit würden *Sie* ausüben ?
- .....
- .....
- 10) Würden Sie die Roboter, denen Sie in der Ausstellung begegnet sind, als intelligent bezeichnen?
- Ja
  - Nein
  - Ich weiss nicht
- 11) Welche von den folgenden Qualitäten beschreiben Ihrer Meinung nach die Roboter, denen Sie gerade begegnet sind ? (mehrere Antworten möglich)
- Intelligenz
  - Fähigkeit zur Empfindung (Kälte, Wärme, Schmerz, ...)
  - Rationalität
  - Sympathie
  - Perfektion
  - Menschlichkeit
  - Fähigkeit zu Gefühlen (Liebe, Freundschaft, Abneigung ...)
  - Präzision
  - Leben
  - Zuverlässigkeit
  - Anderes (bitte angeben) : .....
- 12) Welche von den folgenden Qualitäten beschreiben Ihrer Meinung nach den Menschen im allgemeinen ? (mehrere Antworten möglich)
- Intelligenz
  - Fähigkeit zur Empfindung (Kälte, Wärme, Schmerz, ...)
  - Rationalität
  - Sympathie
  - Perfektion
  - Menschlichkeit
  - Fähigkeit zu Gefühlen (Liebe, Freundschaft, Abneigung ...)
  - Präzision
  - Leben
  - Zuverlässigkeit
  - Anderes (bitte angeben) : .....

- 13) Im Falle des Verlustes einer Extremität (Arm, Hand, Bein, Fuss) durch Behinderung, Unfall oder Krankheit, würden Sie diese durch eine Prothese konventioneller Art ersetzen ?
- Ja  
 Nein  
 Ich weiss nicht
- 14) Im Falle des Verlustes einer Extremität (Arm, Hand, Bein, Fuss) durch Behinderung, Unfall oder Krankheit, würden Sie diese durch eine aktive robotische Prothese (mit Motoren, Sensoren und Mikroprozessor) ersetzen, welche hilft, die Behinderung zu lindern ?
- Ja  
 Nein  
 Ich weiss nicht
- 14.1) Auch dann, wenn die Prothese direkt mit Ihrem Nervensystem verbunden wäre und darüber steuerbar?
- Ja  
 Nein  
 Ich weiss nicht
- 15) Im Falle eines Unfalls oder einer Krankheit, würden Sie sich ein künstliches Organ verpflanzen lassen wenn Ihr **Leben** davon abhinge ?
- Ja  
 Nein  
 Ich weiss nicht
- 16) Im Falle eines Unfalls oder einer Krankheit, würden Sie sich ein künstliches Organ verpflanzen lassen wenn Ihre **Lebensqualität** davon abhinge ?
- Ja  
 Nein  
 Ich weiss nicht
- 17) Wenn es gesundheitlich unbedenklich und technisch möglich wäre, wären Sie bereit, sich ein Mobiltelefon implantieren zu lassen, das mit dem Gehirn verbunden wäre (und das Sie auch ausschalten können)?
- Ja, mit allen Speicherfunktionen (Telefonnummern, elektronische Agenda, etc.)  
 Ja, ohne Speicherfunktionen, nur zum Telefonieren  
 Nein, in keinem Falle

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**Persönliche Angaben:**

Mann                       Frau

Ihr Alter : . . . . . Jahre

Ihre Ausbildung :

In Ausbildung

Ohne Ausbildung

Lehre

Berufsschule

Universität / ETH / HTL

Anderes: . . . . .

Haben Sie eine Behinderung ?

Nein

Ja, welche : . . . . .

## Appendix B: French Questionnaire

Faculté des Sciences et Techniques de l'Ingénieur Institut d'Ingénierie des Systèmes  ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE	 UNIVERSITE DE LAUSANNE Faculté des Sciences Sociales et Politiques Institut d'Anthropologie et Sociologie	<h1>Questionnaire</h1>	No.: <input type="text"/> – F
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**Merci de bien vouloir répondre aux questions suivantes en cochant la case qui convient**

- 1) Quelle image avez-vous de la robotique ?
  - Une bonne image: elle est là pour aider l'humain, pour son bien
  - Une mauvaise image: elle constitue un danger, elle prend la place de l'humain
  - Une image neutre: tout dépend de ce qu'on en fait
  
- 2) L'exposition 'Robotics' a-t-elle modifié le regard que vous portez sur la robotique ?
  - Elle a amélioré l'image que j'en ai
  - Elle m'a donné une moins bonne image
  - Cela n'a rien changé
  
- 3) Comment avez-vous trouvé l'exposition 'Robotics' ?
  - Très bien
  - Bien
  - Moyen
  - Mauvais
  
- 4) Vous imaginez-vous vivant au quotidien avec des robots qui accomplissent pour vous certaines tâches qui vous ennuyent ?
  - Oui
  - Non
  - Je ne sais pas
  
- 5) Si vous veniez à ne plus pouvoir assumer seul vos tâches quotidiennes (âge, handicap), accepteriez-vous un robot qui vous aide à regagner, du moins partiellement, votre indépendance ?
  - Oui
  - Non
  - Je ne sais pas
  
- 5.1) Si oui, préféreriez-vous que ce robot ait une apparence humanoïde (avec tête, bras, etc.) ?
  - Oui
  - Non
  - Cela m'est égal
  
- 6) Toujours dans la situation d'une dépendance au quotidien, dans quel cas vous considéreriez-vous comme plus « autonome » ?
  - Si l'aide vient d'un être humain
  - Si l'aide vient d'un robot
  - Je ne sais pas

- 7) A titre personnel, pensez-vous que la robotique puisse contribuer à votre bonheur ?
- Oui
  - Non
  - Je ne sais pas
- 8) Toujours à titre personnel, attendez-vous de la robotique qu'elle améliore votre bien-être ?
- Oui
  - Non
  - Je ne sais pas
- 9) Imaginons une société du futur qui fonctionnerait entièrement grâce au travail des robots. Les humains ne sont pas obligés d'aller au travail. A quelles activités vous livreriez-vous ?
- .....
- .....
- 10) Qualifieriez-vous les robots avec lesquels vous venez d'interagir d'intelligents ?
- Oui
  - Non
  - Je ne sais pas
- 11) Parmi les qualités suivantes, lesquelles décrivent selon vous les robots avec lesquels vous venez d'interagir ? (plusieurs réponses possibles)
- Intelligence
  - Capacité à ressentir des sensations (douleur, froid, chaud, ...)
  - Rationalité
  - Sympathie
  - Perfection
  - Humanité
  - Capacité à ressentir des sentiments (amour, amitié, haine, ...)
  - Précision
  - Vivant
  - Fiabilité
  - Autre (précisez) : .....
- 12) Parmi les qualités suivantes, lesquelles décrivent selon vous les êtres humains (en général)? (plusieurs réponses possibles)
- Intelligence
  - Capacité à ressentir des sensations (douleur, froid, chaud, ...)
  - Rationalité
  - Sympathie
  - Perfection
  - Humanité
  - Capacité à ressentir des sentiments (amour, amitié, haine, ...)
  - Précision
  - Vivant
  - Fiabilité
  - Autre (précisez) : .....



- 13) En cas de perte d'un membre (bras, main, jambe, pied) à cause d'un handicap, maladie ou accident, accepteriez-vous de remplacer le membre atteint par une prothèse conventionnelle ?
- Oui  
 Non  
 Je ne sais pas
- 14) En cas de perte d'un membre (bras, main, jambe, pied) à cause d'un handicap, maladie ou accident, accepteriez-vous de remplacer le membre atteint par une prothèse robotique active (avec moteurs, capteurs et microprocesseur) qui aiderait à pallier le handicap ?
- Oui  
 Non  
 Je ne sais pas
- 14.1) Et si en plus cette prothèse était reliée directement à votre système nerveux et contrôlable par ce dernier ?
- Oui  
 Non  
 Je ne sais pas
- 15) En cas de maladie ou accident, accepteriez-vous, si votre **vie** en dépendait, de vous faire greffer un organe artificiel ?
- Oui  
 Non  
 Je ne sais pas
- 16) En cas de maladie ou accident, accepteriez-vous, si votre **qualité de vie** en dépendait, de vous faire greffer un organe artificiel ?
- Oui  
 Non  
 Je ne sais pas
- 17) Si cela n'avait pas d'incidences négatives sur votre santé et était techniquement possible, seriez-vous prêt à vous faire implanter un téléphone mobile relié à votre cerveau, étant entendu que vous pouvez l'éteindre ?
- Oui, avec toutes ses fonctions de mémoire (liste de numéro, agenda électronique, etc.)  
 Oui, sans fonctions de mémoire, seulement avec sa fonction téléphone  
 Non, en aucun cas

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**Données personnelles:**

Homme       Femme

Votre âge : ..... ans

Votre formation :

Sans formation       En formation       Apprentissage  
 École professionnelle       Université / EPF / HES       Autres: .....

Avez-vous un handicap ?

Non       Oui, lequel : .....