We Are Living in a Social Submarine! Children Are Still the Better Adults

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Abstract. In three sections some interactions at the workshop "YuMi in Action! Ethics and Engineering as Transdisciplinary Robotics Performance" and related later reflections are summarized. The primary emphasis is to illustrate what transdisciplinarity is and how transdisciplinarity could work as a certain form of scientific cooperation. Therefore four principles of biomedical ethics are applied to human robot interactions just like the VDI codex of engineering ethics. Methodological fundamentals of transdisciplinary cooperation are discussed related to concrete medical applications of the robot "YuMi." In the last section the question of transdisciplinary research is (experimentally) related to the metaphor of "social submarines" and concrete practical issues that endanger real transdisciplinarity. Here we close with the question whether children´s more or less unbiased imagination could be seen as a requirement of real transdisciplinarity.

Keywords. Human-machine-interaction, social robots, transdisciplinary methodology, epistemology, responsibility, security, safety, robot ethics

1. Introduction

The following short paper presents one of several results of our joint workshop "YuMi in Action! Ethics and Engineering as Transdisciplinary Robotics Performance" (for issues of IT security that have been emphasized during the workshop see [1], this volume). But the following considerations are also the result of an overarching intellectual context that would not have been possible if this workshop had not been embedded in the broader horizon of the Robophilosophy 2018 / TRANSOR 2018 conference in Vienna. In this paper we will summarize some of these transdisciplinary interactions, primarily between engineering and philosophy. But also some hypotheses and an disprovable thought experimental claim are discussed. The paper is a documentation of a trajectory of intellectual exchange. It is open ended and includes some claims which need to be further elaborated. In the second subchapter the workshop and our attempts to find ways of transdisciplinary cooperation are shortly sketched out. Accordingly it includes remarks about how to bring together technical reality and social reflection. Four requirements of transdisciplinary research are

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summarized. A third section combines androids, unspectacular non-android robots and one of the many intellectual dynamics that developed during the four days of the conference. Here we combine the four principles of biomedical ethics with the VDI ("Verein Deutscher Ingenieure") engineering codex and a scenario for a therapeutic application of apoplectic insults. We illustrate that the VDI engineering codex provides a framework which can be applied to a concrete robotic application—the ABB YuMi. But we also argue that the four principles of biomedical ethics could play a role in robot ethics as well. Section number four is an open-ended thought experiment which leaves the borderlines of classical academic content. It is a hypothetical reflection about climate change, social submarines and how a joke might turn into reality. We close with the question whether the more or less unbiased imagination of children could be seen as a further requirement of real transdisciplinarity.

2. YuMi in Action, Engineer in Action, Philosopher in Action!

The topic of this section is the workshop and our attempts to find ways of transdisciplinary cooperation including engineering and philosophy. Since the early beginnings of robophilosophy as conference and workshop series in Denmark, transdisciplinarity has always been an important topic. Definitions of transdisciplinarity have been emphasized theoretically, interdisciplinary projects have been presented and many scientists with a wide range of disciplinary background(s) have been actively interacting in several settings. Both, the discussion and in addition the object of investigation—social robots and human-machine-interaction—are characterized by methods that cannot be attributed to only one discipline. Robophilosophy is a research area in which anthropologists, psychologists, and ethnologists play a role as well as social scientists, computer scientists, engineers and philosophers [2-3]. Genuine objects of discussion are various aspects of human-robot-interactions (HRI), which in a wide sense beside conceptual or ethical challenges also include, social political or economic aspects. HRI became a focal point e.g. in social robotics, not so much because of the technical construction of concrete artifacts but due to the deliberate design of social interaction [4-6]. The engineer became a designer of social habits, gestures, language, values and norms. With this development, the objects of engineering (and especially social robots) became more than mere engineering objects: questions of cognition, knowledge, ethics etc. arose immediately out of the praxis of technical developments. It is not only because of the social consequences imposed by robotics but furthermore directly due to the intended functionality that transdisciplinary investigations are necessary.

If a technician designs social interactions, then knowledge and understanding of the relevant domain becomes an important condition for functional success. Classical social-scientific and philosophical skills turn into inherent matters of technical expertise—for instance analyzing social relations or reflecting ethical values in a non-mathematical and non-reductionist approach. Vice versa: for sufficient ethical analyses and technology assessment not only ethical skills and economic perspectives but also differentiated technical knowledge and understanding is required [7]. The robophilosophy conference and workshop series became an intellectual laboratory and joint think tank for transdisciplinary reflections on the one hand. But on the other hand, a differentiated conceptualization of what transdisciplinarity actually means, and how it is different to inter-, cross-, multi- or pluri-disciplinarity, how it methodologically proceeds and how it affects and transforms our understanding of what technology and science actually is, remains generally underdeveloped.[2] We perform—sometimes successful, sometimes failing—transdisciplinarity, but without reflecting on how it works.

Motivated by this observation we aimed to bring together philosophy of technology and robotics engineering in our workshop. Our aim was to realize transdisciplinarity; we wanted to create a dialogue beyond the dualism of the Humanities and natural sciences. At the same time we aimed at contributing to the theoretical foundations of how transdisciplinarity might methodologically work. Our starting point was a definition by Jürgen Mittelstraß, who understands transdisciplinarity as a research principle. Research principle means that transdisciplinarity is primarily a matter of concrete research performances and secondary a concept of institutionalization. According to Mittelstraß, whenever a concrete problem is too complex for one single discipline, then several disciplines start a peculiar form of cooperation. Interdisciplinarity would mean a cooperation where everybody at the end of the day would go back to his/her ancestral institute. Transdisciplinarity changes skills and procedures of participating disciplines within the research process, consequently nobody at the end returns to her/his ancestral discipline. Disciplines are changing, and whenever these changes are caused by a certain problem orientation and cooperation, this is called transdisciplinarity [8]. How is a transdisciplinary process initiated? The field is enormously large—ethics of HRI for instance is as diverse as humans and robots are. But with a closer look at the literature concerning inter- and transdisciplinary methodology [8-11] at least four requirements can be found. The first one seems to be very simple: the motivation to find a solution for a problem. Secondly: the will to struggle for knowledge. Thirdly: an emotional common base and personal sympathy. Even the largest problems and good will can fail, if very personal differences destroy the open communication in a working group. Fourthly: creating a joint definition of the research problem. What is a joint research problem of engineering and philosophy? Here, the simple answer could have been: ethics of HRI. HRI includes three words and it is very difficult—not to say impossible—to find a final definition for each of the mentioned terms: “human,” “robot” and “interaction.” Accordingly with respect to our workshop, one choice could have been to go for general tentative working definitions and to further streamline them during the research process. We decided to go a different way. On the one hand we did not define the terms robot nor HRI, but we put the focus on a concrete robotics application: the collaborative robot ABB YuMi.[3] At the workshop, we did not start by talking about HRI as such, but by talking about the very concrete potentiality of this system. Concrete technical applications of this robot have been practically performed, explained by a robotics expert and commented by a philosopher of technology. Our way was inductive: we started with the concrete empirical example and later on during the discussion we tried to relate to more general definitions.

Therefore, we included a technical performance and virtual lab tour (Figure 1), which was the “engineering” part of the workshop: simple applications of the ABB YuMi (Figure 2) have been presented and explained in terms of technology, realistic possibilities and limitations. YuMi is a collaborative robot and such like other

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2 Some aspects of transdisciplinary methodology have been discussed explicitly at the 1st TRANSOR workshop in Aarhus, 28.-30. Jan. 2015.

3 http://abb.com/YuMi (accessed: April 15, 2018)

collaborative systems it has been trending in research and industry over the last years [12-13]. Robots like that are specially constructed to safely work alongside of humans where contact is possible and sometimes even intended (see [13] for an example). The specific safety requirements of this robot are one important reason why we chose this example.

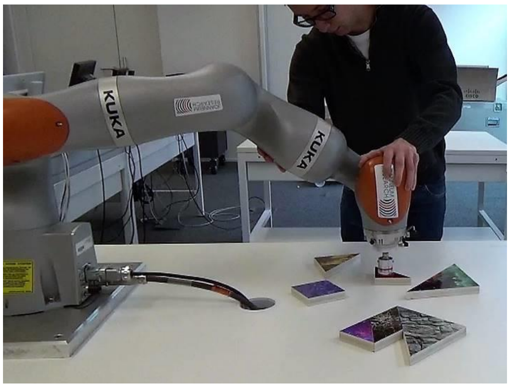

Figure 1. A collaborative robot (KUKA iiwa[4]) working together with a human.[5]

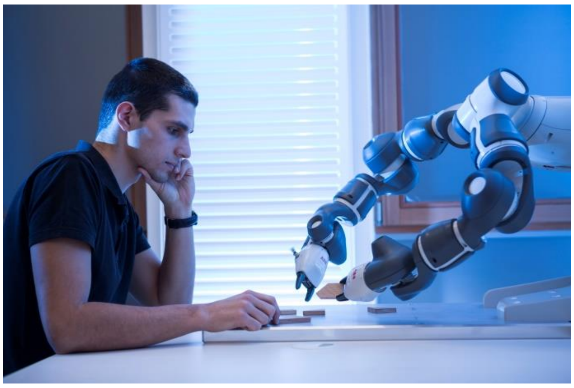

Figure 2. The ABB YuMi building a Tangram puzzle together with a human.[6]

The goal was to show the possibilities and limits of currently available robots for human-robot collaboration. A simple demonstration like building a Tangram puzzle was used to show the abilities of the robot. In this showcase, it used a camera in its arm to detect wooden puzzle pieces in its workspace [14]. From this, it built a user-selected shape. We demonstrated the safety mechanisms like collision detection and force sensitive movement. In course of that, we talked about how robots are currently certified for safety and which regulations must be followed. After the demo, we gave a

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4 https://www.kuka.com/en-de/products/robot-systems/industrial-robots/lbr-iiwa (accessed: April 15, 2018)

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short overview of current research activities at the Institute of Robotics and Mechatronics in Klagenfurt—a virtual Lab-Tour. We show the current industrial robots but also advanced robotic systems available in the laboratory[7] and explained their intended future use.

In addition the aim of the demonstration and of the presentation was to perform a kind of reality check for the conference participants. While some of the discussions within Robophilosophy 2018 / TRANSOR 2018 also tended to revolve around technical artifacts, which are suspected to come in the future (fleets of self-driving cars, general AI, etc.), we wanted to show one example for the actual state-of-the-art as it is currently being brought into industry and the moral and ethical issues we face as an applied research institute working in this field. Facing moral issues like “Do we accept a certain project although the outcome may impact the job situation in this company?” requires careful reflection in the daily work of applied researchers and is much closer than asking questions about what happens to our field in 20 years. Still, it is important to regularly step back from daily business and think about long-term effects of the own research. Accordingly, how can we create a transdisciplinary discussion? There are efforts e.g. in EU funded research to find solutions for the legal regulation of robotic applications.[8] Also the linking of different stakeholder groups plays an important role, e.g. in the INBOTS project.[9] Some of those current EU reports could support transdisciplinary engagement by delivering at least tentative definitions of what a robot is and on how basic legal and ethical problems might be defined.[10] The advantage of this procedure is the use of already established linguistic consensus—if and only if linguistic consensus will be possible at all. It is a very helpful support, when transdisciplinary investigations do not need to start linguistically from point zero. On the other hand many definitions are very vague and—due to the fast dynamics of technological developments—only tentative [8-11]. When we discussed about security and safety in HRI [16], we therefore additionally included already established normative schemes beyond robotics. The ethical focus was on responsibility, safety and security as both technical and philosophical concepts. As concrete a focal point beyond robotics we used the more general VDI ethics-codex *Fundamentals of Engineering Ethics* [17] (which also shapes the *FEANI position paper on Code of Conduct: Ethics and Conduct of Professional Engineers*[11] [18, pp. 181-190]) and tried to concretely apply to the performances we demonstrated with YuMi. Our methodology was also to find already existing linguistic frameworks which could help us to synchronize the ways in which we talked about responsibility, security or safety. What have been the results of our interactions? In the following we would like to present some of our findings.

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7 https://www.joanneum.at/en/robotics/infrastruktur.html (accessed: 15, 2018)

8 http://www.robolaw.eu/index.htm (accessed: June 28, 2018)

9 http://inbots.eu (accessed: April 15, 2018)

10 See for instance the European Civil Law Rules in Robotics (Oct. 2016) [16].

[10] https://www.feani.org/sites/default/files/PDF_Documents/Position_papers/Position_Paper_Code_of_Conduct_Ethics_approved_GA_2006.pdf (accessed: June 28, 2018)

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3. The Struggle for Sensible Robots

After we presented attempts to find ways of transdisciplinary cooperation in the previous section, this subchapter emphasizes some results of the workshop. We illustrate that the VDI engineering codex provides a framework which can be applied to some applications of the ABB YuMi and argue that the four principles of biomedical ethics could play a role in robot ethics as well. Therefore we start with a short remark about androids. Our workshop was situated in the program after the keynote lecture by Hiroshi Ishiguro. Ishiguro presented very impressive high-tech systems, mostly android robots with a human-like surface and advanced capabilities for gestural and linguistic interactions with humans. Compared to that, our presentation of the collaborative robot YuMi immediately after Ishiguros visually stunning statements received a somehow disappointing flavor. YuMi is white and grey, has an upper body like shape with two robotic arms, but no legs, no head, no artificial human-like skin and no features for verbal interaction. It represents a more grounded trajectory of current robot developments. This observation threw us back to the question why to do robotic research and especially research on collaborative systems—an issue we discussed while preparing this workshop before the conference started?

In point 1.4 of the VDI *Fundamentals of Engineering Ethics* it is stated that: “Engineers are committed to developing sensible technology and technical solutions.” [17, p. 4]

In the German version the word “Bringpflicht” is used. It means literally something like “duty of deliver” and relates to a somehow Baconian attitude: scientific and technical progress has also to aim for societal benefits. It is part of engineering responsibility to take this into account. The very last critical question in the discussion after Ishiguro’s keynote was about which human society he is aiming to create with his androids? With respect to our YuMi performance and the Tangram puzzle which was created by the robot, a similar question popped up in our workshop. What is it good for? Again, in a transdisciplinary and pragmatic attitude we did not start out by discussing important but also controversial and therefore time-intense ethical fundamental arguments. We decided to experimentally try to find a realization for strategic responsibility by referring to medical applications. Medical benefits are surely part of sensible scenarios of technical applications. For instance in applied medical ethics Tom L. Beauchamps and James F. Childress’ 1979 released book *Principles of Biomedical Ethics* became a classical source for the application of four pragmatic principles: respect for autonomy, nonmaleficence (not causing harm), beneficence (caring and supporting health) and justice [19]. Those four principles are valid still today [20].

Experimentally we used these rules for thinking about sensible scenarios of care applications as one possible realization of strategic responsibility. A philosophical framework of biomedical ethics was combined with the engineering perspective on the basis of a common language that was also taken from the VDI codex and an EU working group paper [16]. In our scenario, the Tangram game was further developed as a form of physiotherapy, which might be applied in cases of stroke rehabilitation. As consequence of strokes neural damage often causes a decrease of sensorimotor capabilities. In order to reactivate fundamental competences of body movement (e.g. sensorimotor coordination of arms) several kinds of physiotherapies with a high number of linear repetitions are applied and discussed in medical literature as one aspect of rehabilitation [21]. Following that in our scenario the patient is forced to learn simple movements by performing monotone repetitions of body movements. Furthermore, this takes a lot of time from the professional therapists. A YuMi-like robotic application could support the monotone repetitions, also when a professional therapist is not physically present.[12] In terms of autonomy, we argued that a YuMi-like robot could support the autonomy of the patient in two ways: first, it helps the patient to relearn basic skills in order to be able to live an independent life after a stroke. Second, compared to androids a Yumi-like robot does not appear like a human being and therefore there is no danger of uncanny valley effects [22]. We argued that a robot which is clearly recognizable as technical tool will thereby also psychologically support the human autonomy of a patient. Especially forces caused by technical structures—factual constraints—should be avoided in order to support human freedom and autonomy (VDI 2.2): "The fundamental orientation in designing new technological solutions is to maintain today and for future generations, the options of acting in freedom and responsibility. Engineers thus avoid actions which may compel them to accept given constraints (e.g. the arbitrary pressures of crises or the forces of short-term profitability)" [17, p. 5].

The second biomedical principle of "nonmaleficence" (not causing harm) is linked to standards of safety in HRI. This is on the one hand a matter of legal regulation and formulated in the engineering codex in point 1.3 like this: "Engineers know the relevant laws and regulations of their countries." [17, p. 4] Another point is at least as important, but epistemologically speaking much more difficult: dual use. Therefore in VDI 1.4 it is argued that engineers are "taking into consideration the possibilities of unwanted technological developments and deliberate misuse of products and processes" [17, p. 4], In addition to misuse, dual use or abuse, also asymmetry plays a crucial role in HRI [24]. Limitations of sensorimotor capacities of patients are certainly challenging There is no perfect user and especially in medical situations there is a strong asymmetry between the patient, who is ill, has pain and physical limitations, and the robot, who is made out of cooper iron etc., has a physically stronger body, no pain etc. Therefore, modern collaborative robots are equipped with safety-oriented functions, which are supposed to prevent humans nearby from harm. Those robots recognize unintended contacts (with humans or anything else) and immediately stop their motion. Functions like these can be realized in different ways using sensors or using measurements of motor current. In any case, robots like the Kuka iiwa or the ABB YuMi are shipped with such safety measures. It has to be said though, that this alone does not yet make the robot safe in all possible situations. It has been shown, that those safety functions can still exceed the maximum allowable pressure on contact [25]. Rather, the safety of the robot depends on the application it is used in. Thus, for each application, a risk analysis and measurements of biomechanical thresholds need to be performed before the robot can be considered safe in this specific situation.

Even if safety standards in central Europe are set pretty high at the moment—also as consequence of accidents in the past and procedures of optimization [26]—the general problem of dual use and abuse remains very urgent. Every technology is dual usable and it is one characteristic of technologies, that engineers cannot foresee every possible application which might be performed by certain users. Therefore, in the VDI codex the problem of knowledge is addressed in point 3.1: "Engineers are committed to

[12] These observations which have been discussed during the workshop are worth to be further explored with respect to genuine medical expertise and literature. However, the discussion about robots in physiotherapy has already begun: e.g. [23].

keeping up and continually developing further their professional skills and competencies." [17, p. 6] We think that the struggle for permanent enhancement of professional skills in the VDI codex can be interpreted as one link to the second principle of biomedical ethics by Beauchamp and Childress: avoiding harm means avoiding lacks of knowledge.

Biomedical principle number three is beneficence (caring and supporting health). We think with a therapy application this principle is fulfilled. Principle four relates to justice. Without giving a final and overarching definition of justice during the workshop discussion we came to the conclusion that a therapeutic application could—depending on economic factors and legal regulation—both increase and decrease justice. Justice decreases when every patient receives a similar therapy chance for therapeutically treatment without depending on the funding and workload-limitations of human therapists. But it decreases justice if they are applied in context of two-class medicine. In the second case, only rich patients would be in a position to afford expensive robotic applications. The problem becomes even more sophisticated in global context. As it is already the case today, rich countries could provide even better therapy than poor countries. On the other hand, it is also worth mentioning that in some regions like India and others exists inexpensive labor force especially for routine work. In countries like these therapy robots for monotone repetitions might economically not make so much sense. It would be worth to further discuss this scenario, but additionally legal, economic and medical expertise would be required to do so thoroughly. This might be an interesting topic for a future follow-up workshop. In conclusion we argue that both the VDI engineering codex and the four principles of biomedical ethics by Beauchamp and Childress provide an ethical framework which can be applied to a concrete application scenario of the robotic system ABB YuMi. In the next final section transdisciplinarity is again the primary topic. We finish this paper with an experimental question.

4. We Are Living in a Social Submarine!

In the second section we presented attempts to find ways of transdisciplinary cooperation in the workshop and the third one was about some concrete findings. At this point we return to the initial topic of this paper. Here we are going to perform a thought experiment which leaves the borderlines of classical academic content. It is arguable and might receive a lot of counterarguments. But we (the engineer and the philosopher) think it is appropriate to also perform joint thought experiments in order to enable unusual perspectives—and maybe at least trying to find new ways of reframing problems.

Within the robophilosophy conference we reflected on how to proceed with transdisciplinary engagement. Do we need more spectacular android robots the next time as examples in order to be more provocative? Maybe provocation could be a methodological principle of transdisciplinary research. Listening to another keynote of the Robophilosophy conference, the one by Simon Penny, we realized an unintended link between our "unspectacular" non-android robot and climate change. Critically, Simon Penny has been putting attention to urban environments and how we might apply social robots in historically grown cities—since most cities exist for centuries and have been developed without challenges of current robotic systems. He mentioned the impact of climate change and presented some pictures of flooded US-east-coast cities. With the melting of arctic ice, the sea level might bloom in the next decade so that coast cities also might be flooded. Ironically Penny raised the question: “But where to put social robots here between flooded streets?” The one link is a historical and methodological one. Climate research is a classical case of transdisciplinary research since it is not only interdisciplinary cooperation. Climate models are extremely complex, depending on a huge amount of data, as well as physical, geological, biological knowledge etc., which leads to a unique amalgamation of separated disciplines. Climate science or environmental science are new labels for this amalgamation of specific transdisciplinary competences (which in consequence turned into new disciplines). Therefore this field of investigation is in the literature often discussed as classical example for transdisciplinary engagement [8, 10]—even before the word “social robot” became part of public and scientific debates.

During the discussion after Penny’s talk the moderator was kidding by referring to the point with social robots in flooded cities: “...this also makes us think about *social submarines*...” What began as a joke and teaser for discussion turned to become a metaphor for one strong methodological problem of transdisciplinary research—as it was also discussed in the workshop. An underwater social robot could be a social submarine on the one hand. But on the other hand a social submarine could also be a human who makes her/himself scarce, someone who ducks and hides her/himself under the waterline. In our metaphor, the waterline is the academic career system which does not open many opportunities for real transdisciplinary research. Academic careers are often limited to very disciplinary behavior and extreme specialization. The openness for other disciplines is often a very un-pragmatic behavior, especially for younger researchers who want to survive at universities and research institutes and who are unfortunately very often confronted with bureaucratic factual constraints. Also the existential fear to end up in the academic precariat[13], with limited and poorly paid working contracts or unemployment is a strong force to follow non-transdisciplinary career logics—especially since most academic careers start with a dissertation which is related to a certain topic within a concrete (sub)discipline that is also represented at a concrete university. Another career pragmatic problem which furthermore limits real transdisciplinarity is related to what Charles P. Snow called “the two cultures”: the strong methodical, linguistically and institutional distinction between (natural- and engineering-)sciences and humanities [27]. A consequence is the tendency to go into epistemic seclusion: becoming a social submarine which is driven by material needs under the waterline of career pragmatism but not by research problems and freedom of sciences. Transdisciplinarity is too often seen as career killer, also because of a lack of institutional foundations—this has been discussed in the workshop but can also be found in the literature at least as a diagnosis for the situation in Austria and Germany, e.g. [9]. Consequently, it might be possible to experimentally rethinking the VDI codex and point 2.2 which avoids forces caused by technical structures (factual constraints). This could not only be an ethical rule for engineers but also for politicians and scientific institutions. Factual constraints of career pragmatism and academic precariat are the first and most destructive enemy of transdisciplinary research—that´s the hypothesis of the thought experiment.

[13] Social, economic and political aspects of labor, substitution of jobs and the notion of precariat has been elaborated by Guy Standing in his comprehensive keynote “The Precariat in Platform Capitalism” in a broader context. We like to express our thanks for his critical input.

The famous allegory of research as a ship that started discovering new oceans by using empirical data and rationality—given in Francis Bacons starting shot of modern sciences in his *Novum Organum* in 1620—seems to be endangered by disciplinary tunnel views and career factual constraints which will end up as a social submarine in the flooded streets of academic precariat. Was it not a nice time, when we were children and socially allowed to playfully combine yellow with blue bricks without losing any reputation or status? In any case—be it the social submarine, the (more or less) responsible technician, the politician who is responsible for legal regulation, or the everyday person affected by technological change—why not initially in a playful way also engaging children with those topics?[14] We speculate that the technologies that are being worked on in research labs and at universities today are likely to impact society in in a few, maybe 15 to 20, years. Thus, the persons mostly affected are at the time of development still children or teenagers. Sadly, they are not often asked how the technology, which will later impact their lives, shall be designed.[15] Why not asking children and respecting their open, non-disciplinary and somehow naive perspectives on a good life?[16] The point is that not only robots but also education—both by families and by institutions like schools—has an impact on societies. If we treat children like under aged persons (in the sense of individual reasoning and enlightenment) with no influence on their future (beside some career oriented grades in school) then we easily end up in robotic societies.

We think this conclusion can be drawn with respect from the AI critique of Hubert Dreyfus [29] and Joseph Weizenbaum [30], as well as from current publications in the field, e.g. [31]. The main argument of these AI critical approaches is that mathematical calculation and formal logical processing of information is a superior feature of computers and robots. What makes humans become human is also mathematics and rational reasoning, but additionally a wide range of capacities which cannot be such easily substituted by AI: perception, emotions, sensorimotor body movements, linguistic and gestural attribution of meaning in social situations (metaphors etc.), creativity, imagination, and resilience. Reducing a human being to zeros and ones means also reducing a society to zeros and ones—these are metaphorical robotic societies. The crucial question is: What life do we want to live? A robotic life where we are reducing our children to calculable behavior? Or a life in societies that support the development of human skills of imagination, creativity and critical thinking? We think it is important to raise these questions, and listen to the answers of children. And we also think if somebody chooses a robotic lifestyle—which might also be possible in liberal societies—then this choice is once more only possible on the basis of human capacities like real autonomy or real moral sensitivity.[17]

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[14] One reviewer of this paper was critically asking for a threshold. That´s an important argument also in terms of youth protection.

[15] Some empirical studies already emphasized children´s/students expectations (see e.g. [28]).

[16] Two possible counterarguments to this idea have been presented by reviewers of this paper: 1. “The parents are probably their legal custodians and decide on their behalf until they are ready. I guess a child very fond of chocolate would love the world to become chocolate.” and 2. “If I see how my children start arguing on the playground about who is playing with which toy, I am pretty happy to be adult.” But what seems to be true as well seems that also adults, often by using different rhetoric and means, easily behave childish. Unfortunately for instance in (international) politics this behavior can be observed. The difference is that real children are still in a learning process.

[17] In current debates autonomy and sensitivity are discussed as human moral features which might be included in machines only on a very basic level of “operational” and “functional morality” [32].

One initiative to tackle this situation is the "JOANNEUM RESEARCH Summer of Robots". This is a three days event intended to get kids and teenagers involved in the topics of robotics. Besides learning about capabilities and limits of current robots and how they are developed and programmed, one of the three days is especially dedicated to robot ethics and is performed in collaboration between roboticists and philosophers. The kids are engaged in discussions about benefits and caveats of technology and they are given the freedom to think about and design the technology they would like to see when they grow up (Figure 3 and Figure 4).

Figure 3. Kids at the Summer of Robots creating scenarios of robot application without caring about disciplinary borderlines and career forces.[18]

Figure 4. How kids at the Summer of Robots imagined sensible household robots by painting a picture.[19]

We want to formulate the (empirically unproven) hypothesis, that this younger generation has a much more unobstructed view on what technology should be and how we could use it to benefit human life.[20] Are children sometimes the better adults?

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20 A critical objection was formulated by one reviewer: "Compared to who? Was there an adult control group? I think this is essential if this kind of conclusion is to be drawn". We agree. Since this section of the paper is a thought experiment where hypothesis are given it definitely lacks a clear empirical proof. This could be realized by a review of social scientific literature or by creating an empirical evidence with the

Anyway, it seems that they are very open and access their environment with fantasy and unbiased perception.[21] Why should we not already now learn something from the next (human) generation?

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methodic means of social research. In the next step it would also be valuable to compare the results to studies about imagination of adult engineers as it is given for instance in Eugene S. Fergusons book *Engineering and the Mind´s Eye* [33]. But again, so far this remains an arguable thought experiment.

[21] A critical counterargument which we received by a reviewer emphasizes on the fact that also children might be biased, e.g. by commercials, popular robot clichés or science fiction stereotypes. It remains also an open question whether these imaginations differs from “actual imaginations by engineers”. To turn the hypothesis and the thought experiment into hard scientific facts a strictly methodical “review of a broad spectrum of robotic projects and the fantasy, imaginaries of their inventors” would be needed. We are thankful for the critical comments! We, the roboticist and philosopher, at least want to answer with the (unproven) hypothesis that childish imagination—also the childish imagination of adult engineers—by definition cannot be scientifically and disciplinary quantified. If this would be possible robots would have already replaced the roboticists.

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