Care-receiving Robot as a Tool of Teachers in Child Education

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1. Introduction

Since 2004, the first author of the present article has been working on research investigating children-robot interactions. Between 2004 and 2007, the author stayed at the Machine Perception Laboratory of the University of California, San Diego (UCSD) where the author worked with Dr. Javier R. Movellan, and his colleagues. At the UCSD Early Childhood Education Center (ECEC), a small humanoid robot was immersed in the classroom of children younger than two years old on a daily basis for a five-month period (Tanaka, et al. 2007). The author and his colleagues at UCSD also immersed themselves in the daily classroom environment, and made continuous observations on the development of socialization between the children and the robot. The project was part of the RUBI project that seeks to investigate robotics technologies for supporting early childhood education and enriching the educational environment (Movellan, et al. 2005; Tanaka, et al. 2006).

The project involved a wide range of participants: from professionals in early education, developmental psychology, cognitive science, sociology, computer science and robotics to the parents of children, staff in the Early Childhood

Education Center (ECEC), and, of course, the children. From the beginning of the project, all the participants had been involved in the continuing discussion on the various aspects of the experiment while foreseeing the future impact of introducing the new technology of robotics into this early childhood education domain. The discussion often had been expanded into "robot ethics" issues although we did not clearly mention it as ethics. However, we were very cautious of the possible influences on the children involved throughout the course of the experiment. Following the precautionary principle, we paid the utmost attention, particularly, when introducing the robot into the classroom. Over the three-year project, deeply coupled with the daily classroom environment and the associated people, we are convinced of the positive potential of robotics technology as a tool for supporting teachers in their continual commitment to improving the quality of childhood education.

In response to the target article by Noel Sharkey and Amanda Sharkey, both authors of the present article, a robotics engineer and a humanities scholar, will jointly comment from engineering and ethical standpoints, whose goals are to constructively present ways for improving our lives based on technology. First, we will discuss the dynamical balance between the benefits and risks of technology. This dynamical property is also affected by the associated cultural and philosophical background. We will also try presenting a framework for the use of robots in early childhood education which we consider to be ethically safer and thus more acceptable to a wider range of societies.

2. Dynamical Balance between Benefits and Risks of Technology

Every technology has both upsides and downsides. Therefore, it is crucial for us to dutifully recognize both these properties and consider the best possible use. We agree with the Sharkeys' concern regarding the over reliance and dependence on using robots for children. "Replacing human care-givers (by robots)" is the situation that we have been strongly opposed to since the first day of our trial. Robotics technology should be used to support and assist human care-givers so as to enhance their educational actions by stimulating their creativity and alleviating their physical burden.

As a result, robotics technology is expected to contribute to enriching the childhood educational environment.

In the target article, the authors addressed some extreme cases, out of which they derived some warnings and expanded them into more generalized issues. This sort of reasoning needs to be examined for the sake of developing ethical discussions concerning the use of robots. The article discusses the downsides of robot use, but we view it from the balance between the benefits and risks. Surveying the literature is out of the scope of this commentary, but every year there are many successful reports on human-robot interaction. Our view is that the balance between the benefits and risks of this technology is always dynamic, meaning that there has been no static optimality; the balancing point changes over time and across cultures. It also has to be noted that our actions (even research) can affect this balance.

The second author of the present article has recently begun to explore the issue of robot ethics in Japan. With a background in the humanities and social sciences, the author's approach to robot ethics is somewhat different from those of robotics engineers. Robotics engineers tend to forget the fact that the work of everyone, including scientists and engineers, is directed toward technological advances and universal knowledge, and that the applicability of this work is unconsciously engaged and circumscribed in the cultural, social and philosophical framework. When it comes to assessing the ethics of particular cultures and cross-cultural issues, various aspects regarding the introduction of different kinds of robots must be analyzed. For example, a robotics engineer whose social culture has not yet developed any sub-culture of robots, such as robot animation and robot figures, might not be familiar with a situation in which children enjoy interacting with a robot. Those who are brought up in this sort of social culture might not be psychologically ready to see children enjoying time playing with a robot, and might not grasp the precise framework of any experiment. In Japan, many prominent robotics engineers confessed that they were very much interested in watching robot animations during their childhood. Thus, particular sub-cultures may provide an intellectual framework upon which robotics engineers can create robots interacting with humans. This sub-culture

influences a wide range of people living in Japan, and is considered to be one of the reasons why robotics technology is generally accepted in Japan.

At the same time, however, it is worth noting that there have been some cases in Japanese society where a certain technology or product that had been naturally accepted before suddenly was faced with a strong, negative response from the populous after a lack of the regulations needed to assure the quality of the product was disclosed.   Therefore, the generous attitude of the Japanese society toward robotics technology could be dramatically upset by a negative incident.   More specifically, the balancing point between the benefits and risks of the robotics technology from the perspective of social acceptance is also dynamic, and could be affected by the activities of robotics engineers.

After all, the only way robotics engineers can proceed to is to develop technology while continuously observing and listening to the responses of the society.   This is one of the reasons why we have been researching children-robot interactions by immersing ourselves into the actual classroom of a nursery school in California.

3.   Robot as a Care-receiver by Children

In this section, we present a framework for using a robot in early childhood education which we consider to be ethically safer and thus more acceptable to a wider range of societies.

As was reported in the target article, "childcare-robots" are already on the market.   People will certainly be finding appropriate ways of using this technology, but it remains the case that the use of childcare-robots encompasses sensitive issues as were pointed by the target article.

From our observational study conducted so far (Tanaka, et al. 2007), we have found another type of children-robot interaction that is more appropriate and rewarding than that with childcare-robots.   In contrast to the robot which takes the role of a human care-giver (Figure 1), here we consider a reverse-scenario where a robot is supposed to be *a care-receiver* from

children (Figure 2).   The image in Figure 2 is an actual snapshot from the continuous observation we made during the long-term field study of children-robot interactions at a nursery school (Tanaka, et al. 2007).   In the present article, we consider the design of the framework for the purpose of education by teachers/parents.

[FIGURE 1 ABOUT HERE]

[FIGURE 2 ABOUT HERE]

Observations indicated that children were very motivated to interact with the robots, particularly the robots that were in some sense "*weaker*" than the children.   Here, by "*weaker*", we mean that we introduced a small humanoid robot (height: 58 cm) which was much sophisticated than other conventional toys at the nursery, but not as sophisticated as the children (for example, the robot was capable of walking using bipedal locomotion, but its speed was much lower compared to the children).   During the daily classroom activities over the course of a five-month period, children had taken care of the robot much more often than other objects, such as an immobile robotic toy (Tanaka, et al. 2007).   We consider this phenomenon from the perspective of children *learning by teaching* as follows:

First, teachers/parents decide the educational topic depending on the group of children in the classroom; examples include child disciplines such as expressing greetings or words of appreciation.   Teachers then ask the children to teach the topic to the robot.   The robot is equipped with basic functions for generating dialogues, although it is not perfect and the robot often makes mistakes at the beginning.   As the instructions from the children increase, the robot learns the task slowly, with the expectation that the children will be motivated with completion of the task itself as a result. Thus, the whole process can be viewed as an indirect practice for the children.

The scenario is based on several assumptions.   First, although we have stated that a "weaker" robot is going to attract children's interests well and it motivates their will to take care of it, we actually need to verify it with more

cases. We have observed a case but it is true that the experimenters might have helped children to do so indirectly since they instructed the adults in the classroom to treat the robot as if it were a new child in the classroom, which could have contributed in children's vigorous care-taking behaviors towards the robot. Second, we have no idea to what extent the effect of children's active teaching is going to have on their own learning. There could be another assumption that a robot is an object with which children can easily feel empathy, and care-taking behaviors towards the robot can easily be regarded as their own behaviors toward other people. Finally, there are also difficulties in analyzing and assessing the impact of interacting with robots on children's personal development because there is no way to know whether or not it is personal genetic traits or the social environment that contributes to the child's personality, cognitive capacity, and emotional growth.

The framework, however, of applying the use of a care-receiving robot to the educational activities of teachers/parents seems to be more acceptable to societies than the conventional childcare-robots since it is a natural extension of the regular care-giving and care-taking exhibited by children. Moreover, it is also important that the framework assumes the continuous attendance of human adult care-givers from the start to the end of the activities. Children will ask the adult care-givers many questions when in trouble, and the adult care-givers also want to see how the children learn.

4. Conclusion

In reaction to the target article presented by Noel Sharkey and Amanda Sharkey, we stated our view from both the engineering and cultural-ethics standpoints, attempting to be constructive in presenting ways to improve our daily lives based on newly developing robotics technologies. We also explained the unwritten ethical discussions concerning the original purpose of introducing a robot into a nursery school, as well as the learning process for both researchers and society as a whole. After discussing the dynamical properties of the benefits and risks of technology, we described the use of a robot in early childhood education that is different from the childcare-robots discussed in the target article. What we observed and subsequently

considered to be more acceptable than the childcare-robots was the situation in which a robot was a care-receiver from the children.   We then proposed an educational framework where teachers/parents can utilize the care-receiving robot as a tool to promote children's learning by teaching.

References

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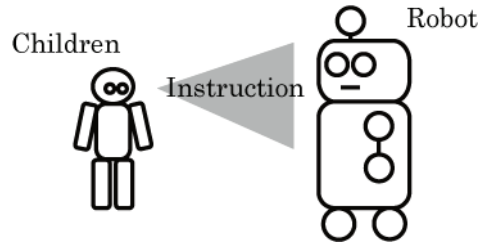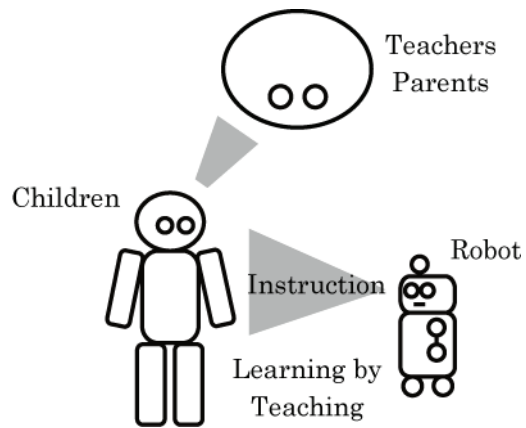
Figures

Figure 1. Childcare-robot

Figure 2. Care-receiving robot