Afterword: Robot Conceptualizations Between Continuity and Innovation

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ABSTRACT
The aim of this afterword is to discuss a topic that links all the papers presented in this special issue. This transversal topic is the forms of social robots. Firstly, social robots form is discussed in light of the forms of robotics we have inherited from the past. This includes the models of society that each of them embodied, as well as the social logic of the emotions connected to them. Secondly, social robots form is analyzed in light of the arrival in a new area for robotics, that of robots in the domestic sphere. Here, the system of filters created by the mass appropriation of information and communication technologies in the last two decades, has set the premise for a change of the social contract that has made social robot penetration possible. Whilst exploring the models and the meanings of social robots in the domestic sphere it emerges that robotics is following two different paths: one addressing the material part of housework (more traditional robotics) and the other addressing the immaterial part of reproduction work (more innovative robotics). Finally, the paper analyzes the dematerialization process of social robotics that is still taking place, a practice that is defined herein as "ubiquitous social roboting."

KEY WORDS: social robots, social robots form, ubiquitous social roboting, social contract change, robotics and immaterial labor

INTRODUCTION

The aim of this afterword is to propose another point for discussion that did not emerge clearly from individual papers but is evident when reviewing the combination of all the papers. This point is the forms that social robots take and how this can be further explored by building on the various contexts examined by the authors in this special edition. In order to explore this point I look firstly at the forms of social robots and how they manifest in various media and research. Secondly I examine models and meanings of social robots in the domestic sphere in which the competing and complementary roles of social robots are discussed. Finally I conclude with the notion of ubiquitous social roboting in which I propose a new way of looking at this topic that addresses the dematerialization process of our everyday lives.

FORMS OF SOCIAL ROBOTS

One crucial point of the current research on robotics is how to define the form we give to the robots we build. In this endeavor we can take two paths: one is to rely on the past and choose from the representations that have characterized the history of technology from antiquity, and another is to explore new paths. Obviously the representations we have inherited from the past convey safety because they are familiar forms that signal continuity, but at this point, a new, innovative effort is needed. Nowadays contemporary societies present a sophisticated technological system in which each technology resonates and is enhanced by the others. This has lead to new opportunities for robot forms. A new approach is suggested here that tries to take advantage of the innovations that have shaped the territories of the immaterial labor in the reproductive sphere and that proposes a new way to conceptualize the forms of robotic life. Looking back the past, four main representations can be identified:

- the robot as zoomorphic representation;
- the robot as android or gynoid (Carpenter et a., 2009) that is a perfect machine in its attempt to imitate the human being where a series of historical experiences such as the automata, the wax replica, the creation of the double (Rank, 1925) converge;
- the robot as machine with a very different profile from human beings, in which the identity of the robot must be clearly something very different. This model is inspired by human characteristics but it can also expand them. Consider, for example, the robot whose limbs can turn 360 degrees or whose neck can be extended according to the needs;
- the robot as a particular object, such as in the case of the automatic musical instruments built by Erone (Trabucco, 2010).

These representations suggest the prevailing rhetorical strategies for the form of robots: displacement in the first case, similarity in the second case, dissimilarity in the third and fourth case. These representations have been present in our imagination from ancient times. In antiquity the robot was mostly created as a zoomorphic and android representation. In particular, the most ancient automaton whose memory has been handed down is the dove of Archytas, whereby the story of robots has begun with the zoomorphic representation. This representation can be explained by reasons that become evident when we look at the history of robot construction. If we turn to the Middle Ages, for example, we discover that only animals could become automata. This limitation to the animals was of teleological origin, because the power to create an object in the image and likeness of a human being demanded that an individual able to do so would be similar to God. For this reason, according to Allegri (1991), Christian culture set a negative relationship with artifice and artificiality from the beginning. Although religion has lost its normative strength on shaping the

public opinion about robots, the importance of religion as a factor that is capable of influencing the social attitude towards social robots is remarkable, as Halpern and Katz show in this same issue.

However, even though such limitation does not exist, animated objects were also built mainly in the form of animals in the East. The chronicles of the time reported that in the Celestial Empire the French goldsmith Guillaume Boucher erected for the Great Khan a tree of silver, which distributed drinks and at whose base there were four lions. A Ming official described many automata: heavenly tigers and devils dancing on a terrace, coiled dragons that exhaled perfumes, and boats in the shape of dragons that opened and closed the jaws. The spread of these Chinese forms intensified both in Asia and in Europe the mid-200 (Baltrusaitis, 1982, pp. 187-188).

The idea of a human being created with magic or artificial tools in competition with the divine act of creation, is a very old one. Of particular importance in the Judaic-cabalistic tradition is the myth of Golem, a kind of human-robot. Golem's creation followed the various phases of the divine creation that were first to model a simulacrum, then to animate it with the magic of the word, and to end with the rebellion and disobedience of the creature. But although all the phases of the divine creation were respected, the human creature was not able to reflect humans' image: it was appearing just as a slave and moreover inclined to evil (Chevalier & Gheerbrant, 1987, pp. 523-524). Furthermore, Golem was mute because humans had not been able to give it the spoken word: it was a kind of shape without soul. This artificial creature, oscillating between matter (its root) and antimatter (its ideal) (Dal Lago, 1991, p. 237), also had the ability to grow very rapidly, becoming gigantic and overwhelming. Its strength could provoke terrible catastrophes, because Golem was only capable of bad actions.

Hence, the fear that the robot could rebel and attack humans comes from the most ancient myths and the most archaic figures of humankind's imagination. This fear continues to be present in contemporary imagination. But fear was not the only emotion involved in this story; wonder was also involved. Aristotle, for example, liked the automata (called Thaumata) for their capacity to surprise intellectually and to stimulate theoretical questions. Another emotion involved was the envy on the part of males both of the creative power of the divine and of the feminine power to give life. Faced with this ability they do not possess, men have often pursued the dream to create a human being with the scientific knowledge at their disposal. The golem, the automaton, the android and the robot, represent not only a challenge to God, but also men's secret desire for motherhood, their hidden dream of being able to steal the power of women to have children.

In the western world the founding fathers of the automatons were mainly Egyptians, Assyrian-Babylonians and Greeks but all over the world many populations worked in this field: Chinese (the first Su Song's clock tower which was an automaton), Japanese (who built mechanical servants with automatisms called *karakuri*) and Iraqi (Al-Jazari), not to mention the Maya and Inca. In Greece, after Aristotle, the technology of machines and especially of automata developed quickly in the Hellenist, and especially Alexandrian, environment thanks to pneumatics, which was the science studying the property of fluids in movement through steam and compressed air. Automata, in fact, were not only mere objects of entertainment but, as explained by Ferrari (1984, pp. 225 onwards and following), they were also "ostensible equipments," that is general instruments of application and demonstration of mechanical principles, and particularly pneumatic.

It is well known that the Alexandrian anatomist, Erasistrato, was the first to build a wonderful automaton. After him, argues Vegetti (1991), the human being and the machine continued to be thought of in a circular relationship, in which the automaton is required to reproduce the human being and in which, in turn, the human being is conceived in the image and likeness of the automaton. But the figure which probably anticipates the automaton even more is Talos, a being made of bronze, half human being and half automaton, whose task was to protect Crete. By virtue of its metallic nature, it could jump into the fire to become hot and then to pursue the enemies forcing them to a deadly embrace. Talos was kept alive by a single vein that crossed its

body from the neck to the ankle, where it was closed by a nail or by a membrane, to prevent spillage of its vital liquid. This living statue was created by Hephaestus for Zeus, who presented it to Europa. It was a gigantic automaton that was invulnerable, except in the point of the ankle, where the only vein containing the blood was visible. Talos, as Apollonius of Rhodes tells, was defeated by Medea, the sorceress who bewitched and enchanted.

In the Renaissance the idea of the automaton regained momentum and it situated automata in a pleasant place: the garden of lilies. The complex machinery of the Medici garden became the foundation of the experimental science along with the Cartesian theory that sought the mechanical laws that govern living organisms (Parlato, 1991). In this period of time there is a growing awareness that the construction of automata requires not only the contribution of science but also of art. Placed as a hybridization between nature and art, the automaton, which belongs to the 'heterogeneous' class of wonders and 'effects ad extra,' can also be a fountain, where the flow of water in the containers that collect or pour it (e.g. the skins, and the bucket of the Samaritan woman, the cup of the farmer with the dragon) obeys a rhythm adjusted on the regular intervals of a gesture metric (Rinaldi, 1979, p. 156, p. 169).

Moreover, the polemics on the alleged, demonic aspect of automata was continuing and was attributed to the magic halo that surrounded them and that derived from the delay with which the public understood the truth of the artefact or even from the impossibility on the part of the public to understand this. This point has to deal with the old issue of 'authenticity' concerning the robot, which Naomi Baron (in this issue) analyzes. Baron's article focuses on the problem of the infringement conveyed by automata as their aims were to surprise but also to trick the public. The issue of authenticity crosses the long story of robots especially in their representation as androids or gynoids. The social contract in fact is based on a high degree of authenticity of the individuals and their social identity. It is true that humans do not always pursue authenticity and grant themselves various degrees of freedom in playing with inauthenticity, but at a certain point one has to come back to authenticity. The foundations of any society are built upon authenticity, a basis on which humans will to some extent derogate, albeit only tactically rather than strategically. Hence the theme of authenticity brings further elements inside the question of the possible role that social robots can play in contemporary societies.

Between the sixteenth and eighteenth centuries, curiosity and passion for automata have lead to a more sophisticated construction of robots. They developed within a scenario of medicine that was completely changing - in particular anatomy. Although up to the sixteenth century the interest of anatomists was directed to study the human body from a static point of view, in the seventeenth century they began to give priority to the study of the human body. Harvey applied dynamics, the science of motion of the bodies, to the problem of blood circulation, founding with his studies and experiments the modern physiology. Descartes conceived the human body as a machine whose functions could be understood through mechanical models not dissimilar to the workings of machines that were based upon levers and pulleys (Fye, 2003). The idea of the living being as a machine acquired considerable importance with the development of experimental technology, and also the construction of artificial limbs (Zanca, 1991, p.33). The French surgeon Paré (1509-1590), driven by the need to provide prostheses to maimed soldiers, developed complicated mechanisms for arms and hands. Programs that explored the decomposition of the body-machine were continued by many researchers in the second half of the 17th century such as in Padova where Girolamo Fabrici d'Acquapendente released two major tables depicting the prosthetic being during this time.

At the end of the eighteenth century great importance was assumed by Von Kempelen's studies on the human voice: the iatromechanical approach influenced the construction of dismountable models to show the structure and function of sense organs. But, as Zanca (1991) recalls, those who brought the idea of the human-machine to the extreme were De La Mettrie and

Jacquet-Droz, who, in particular, developed three androids (the Scribe, the Designer and the Musician) representing the best results obtained with traditional mechanics.

The first true automaton to enter the fairy-tale tradition, argues Landucci (1991, p. 176), is Pinocchio, one of the early contributions to a long series of the automata that spread much in the boundless world of the cinema. The android and gynoid have visual characteristics and structural features that might be more disturbing symbolically when the infringement of anthropomorphic appearance reaches very high levels. In fact, there is not only the problem of counterfeiting and of the very essence of the object in question, but also the issue of the "uncanny valley" (Freud, 1919). Androids can be perturbing since the animation of a thing that should be inanimate involves the very essence of the movement, which appears in this case an illogical or unexpected mobility. Given that movement is synonymous with life, the appearance of life in the movement suggests in fact greater concern than stillness whilst looking alive. However, as we will see the disturbance aroused by androids might depend also on other reasons.

With the advent of a large-scale industry, we have gone from automaton to the robot. Different from automata, robots do not aim to refine the imitation of their inspiring entities. They are only finalized to replace the material capacity for work of humans and in their last version of social robots, also the immaterial capacity of care. This shift represents in reality a leap (Baudrillard, 1990, pp. 64-66). We passed from the mechanical and theatrical counterfeit of the human being, where the technique served to build the analogy and the effect of simulacrum, to a technical principle that is able to produce the equivalent of a human being, considered as worker. While the automaton had to astonish and entertain the public in attempting to be more natural than the human being, a perfect double, the robot (which also in the etymology of the word coming from the Czech word "robota" meaning "hard work") does not pursue the similarity to human beings, but only the will to demonstrate its mechanical effectiveness in comparison with human capacity for work. The only law it challenges is that of value.

The model of society that is embodied in the robot is quite different from the model that was embodied in the automaton. The magnitude of the challenge is more limited now: there is no longer the challenge to God and to women. The dream is set aside and this time the starting point is considering the human being only as worker. It is the secrets of the capacity to work that are observed, stolen and reproduced in a machine: the robot. The motivation behind the third type of robots is the reduction of fatigue and danger in the labor world producing commodities or services (also regarding wars) or the improvement of precision of the work itself (like in surgery robotics). These motivations may vary according to the specific sector of human life which becomes robotized and in which the works and the professions to be substituted are defined. Here the logics of dissimilarity may work better because the imitation and the simulation of human beings are limited to only one aspect: the capacity to work.

The robot becomes the basis for the development of the automation process in the factories. It replaces workers in repetitive or dangerous tasks, but it is also used to transform workers in a superfluous population inside the labor market. Hence, robots are both beneficial and harmful especially when they are put in competition with workers. If there is a large offer of cheap labor, the use of robotics stops. When this offer diminishes, at least in perspective, or the human labor becomes too expensive, robots are possibly introduced.

THE ARRIVAL OF ROBOTS IN NEW SPHERES OF HUMAN LIFE AND THE CHANGE OF THE SOCIAL CONTRACT

All the models analyzed so far have demonstrated the history of robotics and have prepared and nourished people's imagination over the course of time. Along with the myths and the chronicles telling us about the marvelous creations of automata, these models have continued with science

fiction and cinema. Like all the models that have lasted for centuries, they have developed a strong inertia in shaping our conceptualization. However the new wave of robots are emerging in a completely different scenario. With the new millennium robotics from the industrial sector has moved to colonize several other dimensions of public life such as hospitals, armies and so on. But the most radical change in robotics has been the starting of their penetration in the domestic sphere where the material and immaterial reproduction of workers is carried out. The robots have moved on to become "social" robots and as such they aim to substitute at least some parts of human caring such as company, affect, communication, and entertainment.

This shift however has been possible because the electronic culture in the domestic sphere had developed an efficient system of filters among individuals inside the communication process as well as between the self and the reality (authenticity). From telephone wires to computer or mobile screen, different filters have created a huge backstage of the communication process.

A cone of shadow has encompassed the human body making it invisible in its real life and individuals have begun to suffer an increasingly fluid identity. Some portraits or even videos may accompany a profile in one or other of the current social networks, but in the majority of mediated communication the body still remains concealed. It is for this reason that emotions are submitted to a remarkable under-expression or compression (Fortunati, forthcoming). The existence of these filters had brought a profound transformation of the social contract and it developed in this way over the course of time. The change in the social contract happened not so much at a legal or regulatory level but at the level of its practical expression and application. In particular, this strategic change had impacted areas such as responsibility (Bier, Sherblom, & Gallo, 1996), trust (Uslaner, 2004), and control (Kraut et al., 1998), making these important aspects of the social contract increasingly indirect and thus difficult to perform and assess.

If one compares mediated and immediate communication, it emerges that in co-present communication the physical and emotional presence of the human body regulates social relationships in a manner that the individual identity is made quite clear and evident (Vincent & Fortunati, 2009). Both interlocutors can control one another and the context of the social engagement, because of their reciprocal trust, is based upon a rich display of signs. On the contrary, in mediated communication electronic dispositifs (Agamben, 2009), with their specific filters, make the reciprocal control only partially possible, and in turn, the under-developed sense of social responsibility, which derives from the limitation of social control in the absence of the body, shakes the foundations of the social trust and thus of the social contract. In their own social exchanges people have increasingly become less visible and more diffident. Of course, recent developments have introduced more multimodal communication, in which image, sound, and text collaborate together in the codification and de-codification of the message. This type of communication removes some previous limitations and gives more visibility to the human body (Kress, 2010). However, people do not always react negatively towards the filters, because in the meantime people have also learnt to take advantage of these filters and experience different modalities of communication, which have, on the whole, enriched their communication possibilities. An example of this is the difficulty for Telecoms and operators to commercialize the video-telephone. After many decades of using simple fixed telephones which completely filtered the vision of the body of the two interlocutors, people do not now appreciate the possibility of having a telephone augmented by images (especially the face) of both interlocutors (Lewis, 1984).

In the last two decades the volume of the various forms of mediated communication has increased and the volume of communications in presence has decreased in the social sphere. For dealing with these transformations, the foundations of the social contract were tempered and humans learned to coexist and to make society in a more labile way. These steps are the basis for the arrival of social robots. In fact, these same issues of social responsibility, trust, and control are also fundamental to social robots (Bicuspids, Croissant, & Restivo, 2006). Consider, for example,

"battlefield robots," the autonomous mobile systems with the capability of shooting to kill. The aim of the research on "battlefield robots" was to reduce casualties, especially of the military personnel who must operate in high-risk settings. However "battlefield robots" research poses a serious problem of responsibility. The decision to shoot, injure, or kill another human being is made by the software algorithms, which are embedded within them. But does it mean that the responsibility to make a choice between life and death is given to a machine? In reality, it might belong to those who built the algorithms. If the diffusion and appropriation of ICTs have entailed a radical change in the social contract, the arrival of the robots in new spheres of the social life will require further changes of it.

EXPLORING MODELS AND MEANINGS OF SOCIAL ROBOTS IN THE DOMESTIC SPHERE

Entering into the domestic sphere and the everyday life, the form of robots has in turn become an open problem. In the environment of commodities production, the automatization process has always been weak in dealing with the creative, aesthetic, sensorial, emotional aspects of the several tasks involved in it. In the reproduction sphere, the sphere of family, housework, care work, and affections, this weakness has been shown to be even more dramatic. This sphere in fact has traditionally included the most precious part of human life, which is concerned with the production and reproduction of humans (Fortunati, 1981). Here the penetration of robots had to take two different paths; firstly a path robotizing the material part of housework, such as the robot cleaning the house, cooking, or ironing (fourth model), and secondly another path leading to the robotization of the immaterial part of housework such as communication, emotion and so on. The fundamental worker in the domestic sphere has always been women, although all the family members were involved to different degrees in the reproduction process of individuals. The main characteristic of this work is the fact that it is unpaid and not regulated. Interestingly, the more women's involvement in the external labor market has increased (but not the commitment of the state in providing adequate social services), the more women's presence in the house has remained without assistance or, in the wealthier households women were assisted in regard to some tasks by immigrant women (Fortunati, Pertierra, & Vincent, 2011).

Right now a variable part of housework and care work is carried out by migrants and especially by migrant women. The socio-economic model involved in the domestic sphere is that when women cannot guarantee their personal, unwaged housework at home, the family has paid for somebody else to replace their work. This model tends to substitute unpaid and personal care with paid and abstract care, but it still replaces human work with human work. However, the model poses two challenges: firstly, the current economic crisis does not enable a sufficient amount of family income, and secondly, availability of the migrant labor is limited. The social robots are aimed to be an implicit answer to this situation, offering partial, yet perhaps economical solutions, to some of the problems connected to the reproduction, especially that of weak social subjects such as children, ill or disabled persons and elderly. However, what has to be stressed is that the solution "social robots" start from the assumption that the current model of society will not be questioned by citizens. This vision is inert and simplistic as social scientists know that the engine of social change is the multitude's subjectivity, social conflict and political initiative. This problem does, however, need to be set aside for the moment in order to remain focused on the discourse on robots' forms.

In the first instance, the social robots targeted at everyday life tasks have kept the old models. This applies especially to robots with zoomorphic or machine-like representations that have begun to spread in the domestic sphere. It suffices here to think of Tamagotchi, AIBO and Paro, for the immaterial part of reproductive labor (Hutson et al., 2011) and of Roomba (Forlizzi, 2007) for the material part of housework. Interestingly Forlizzi's study shows how the arrival of Roomba

stimulated families to clean more often, to renegotiate the division of labor inside the family (men, for example, were cleaning more than before). As Hutson et al. (2011) argue, and as we will see below, much of the current research "literature about social robots for elderly focuses on devices that can provide assistance or support to people with physical or mental health problems" (p. 579). Broekens et al. (2009) also report that a recent review of the studies focused on social robots for the wellbeing of the elderly found that a) most studies were carried out in Japan; b) they investigated Paro and AIBO; c) they were conducted with elderly people in nursing homes. Hutson et al. tried to verify in the UK if social robots could help to improve wellbeing in the elderly, possibly by reducing their loneliness. They found that participants in their research were mostly unsatisfied with the social robots and that participants expected that animal-type robots behaved like real animals. This study, like Shibata's research (2004), also found that the participants more easily accepted unfamiliar animal-type robots than familiar animal-types because people were less able to compare them unfavorably with the actual animals (Hutson et. al., 2011).

Hutson et al.'s and Shibata's studies raise a well known question among scholars. Even if the religious anathemas have lost their strength, there are psychological reasons that continue to block the personal and collective acceptance of social robots when they are too similar to human beings or animals. This question is that of the "uncanny valley" sketched by Freud (1919), finalized by Mori (1970) and masterfully discussed by Höflich in this issue. Social robots cannot be too similar to human beings because in this case a reaction of discomfort develops. If a certain degree of similarity is achieved by social robots, that is, if their appearance seems to authenticate their humanity, users feel cheated when they discover that an entity that looks human is not. A too high degree of similarity with humans by social robots provokes in the users an effect of "uncanny valley" when they discover that social robots are not humans. This could be because too much similarity violates the mental representation we have of the machine.

Remaining on the social robots with zoomorphic representation, let me focus for a while on Paro that is the most studied social robot so far. Paro is modeled after a baby harp seal. It is covered with soft artificial fur to make people feel comfortable, as if they are touching a real animal. Paro has five kinds of sensors: tactile, light, audible, temperature, and posture sensors, with which it can perceive people and its environment. With the light sensor, Paro can recognize light and dark. He feels being stroked and beaten by tactile sensor, or being held by the posture sensor. Paro can also recognize the direction of voice and words such as its name, greetings, and praise with its audio sensor. Although a real baby harp seal spends most of the day sleeping, Paro is active during the daytime, but gets sleepy at night like a human. Inoue, Wada and Ito (2008) argue how this robot has been designed for two market niches: those who cannot take care of real animals and those who live in places where pets are forbidden. Since research seems to show that Animal Assisted Therapy has positive psychological, physiological and social effects on patients, Paro is used by occupational therapists in place of true pets. Inoue, Wada and Ito did a qualitative research with 20 occupational therapists: the results describe Paro's merits (e.g., "it is so pretty," "touch sense is very good") and demerits (e.g."Paro's body is so firm," Paro's weight is too heavy," "Paro's outer shape gets dirty with time") as perceived by the patients.

Wada, Shibata, Saito and Tanie (2004) studied the long-term effects of Paro presence in a group of elderly. Paro was made available in a health service facility for three months and in a day service center for five weeks. The applied methodology was quite complex (face scale, geriatric depression scale, comments of nursing staff). Results show an improvement of the elderly's moods and depression and a stability of their interest towards Paro. On the other hand, Gerderblom, Bemelmans, Spierts, Jonker and de Witte (2010) stress an important concept: the availability of a technical system as such is insufficient in itself for an efficient inclusion of social robots inside an healthcare institution. They reported about Paro's application in three care institutions for psycho-geriatric patients in the Netherlands, arguing that interventions need to be defined describing goal,

target group, environment and how care staff should be used to pursue effective application. Shibata, Kawaguchi and Wada (2009) present an interesting investigation on people living with Paro at home. They report, for example, that in 1999 in Japan 3000 units of AIBO were sold and 2000 in US and that sales stopped in 2006. At the moment we do not know how many people bought Paro. However, some partial data is available. Of the questionnaires sent with Paro to its owners in Japan, 85 came back. Among the 85 respondents, 22 males (25.8%) and 61 females (71.7%). Main results are that female owners seemed to accept Paro more naturally than males; that the majority of owners liked animals and had kept pets before but could keep pets no longer; that both males and females liked to touch and hug Paro, but females also liked the tactile sensation of Paro. Both were equally satisfied with Paro, but maybe for different reasons (Shibata et al., 2009).

A new field of research called human-robot-interaction aims to investigate and understand the interactions which develop between humans and robots. When approaching the field from a communication science perspective, it is fundamental to ask in which sense they are social as Höflich argues. Given that "they are not a medium through which humans interact, but rather a medium with which humans interact" (Zhao, 2006, p. 402), generally social robots do not provide more options to get into contact with other people. They appear instead as a surrogate, a para-social interaction (Horton & Wohl, 1956). Nevertheless, an emotional bond can be created in the relationship with social robots in the same way we express our emotional investment in objects (Zhao, 2006). Hence, more than a communicative tool, they seem to be more affective tools.

They are affective technological artefacts rather than social (cf. Linke, Lásen and Barile in this same issue). They represent in fact limited communication skills. The sentiment of wonder that was so strong in antiquity has now given space to an articulated range of positive emotions such as interest, joy, relaxation, company, amusement, satisfaction, curiosity, enthusiasm, and surprise (Vincent & Fortunati, 2009). The relationship with technologies has in fact become more personal, close and familiar, but the fear of losing control over technology did not disappear. Meanwhile this fear is at the basis of the laws of robots, but also of the diffidence of Europeans towards social robots (Taipale, Sarrica, de Luca, & Fortunati, forthcoming).

A further important aspect of social robots, connected not so much with their forms but rather with their meaning is their relationship with toys and the sense of playfulness that toys embody. In the sixties the dolls have begun to become increasingly sophisticated, being able to say some words, as Vincent argues in this issue. In the eighties robots became common toys for boys being products developed out of cartoons about robots. These cultural products for infancy have reintroduced into the robots the sense of playfulness that they had lost with industrialization. The tradition of the toys has converged on social robots, probably because now these are now addressed to the domestic sphere and in particular to two segments of the market (children and elderly). Of what are pets and toys metaphors in the communication process? They embody the passion for playing and the narcissistic preference for a unidirectional communication. Furthermore, pets and toys have both a strong transactional power that brings with it a nostalgia for our childhood.

What then, is the difference between Paro and a teddy bear or an advanced dolly? Shibata, Kawaguchi and Wada reported that Paro's owners were especially women and that they considered important that they "can touch and hug" Paro as well as his "tactile texture." So it seems that haptic communication is involved, which is the most basic and primary form of communication. When we were born, we experienced tactile communication at unidirectional levels as we undergo the caresses of our mother. When we grow older haptic communication generally becomes bi-directional. It becomes an exchange but we are still able to invest haptic communication on objects, which thus become transactional objects. Paro is a more sophisticated teddy bear. Paro and Tamagotchi represent a surrogate of affectivity and they operate in the intertwining of a human baby and a pet.

All these historical models entail – as we saw - different meanings and emotion. We saw, for example, that the zoomorphic representation was pursued in the past because of the teleological

anathema against building an automaton too similar to the human being. Although in many countries this anathema remains, now the choice to produce zoomorphic robots is based on other motivations; for example, to create a product responding to cocoon culture among children and adolescents so spread in some Asian societies such as Japan and China. Understanding and discussing these motivations is an open question. One motivation could be, and this is the case of Tamagotchi, to build a robotized pet to teach children caring behavior by simultaneously reducing the amount of work that true pets entail. Probably the real meaning of this sociable robot is that it is easier to ask children to care for this robotic pet instead of providing robotic care. Another motivation, and this is the case of AIBO, Paro and so on, is to allow elderly and ill persons to develop a caring behavior and to develop an emotional relationship with them, without having the burdens that mothering and fathering in general require. Another motivation is to have fun and entertain, something similar to our heritage from antiquity where the automata had also the function to be ostensible.

In this new context of robotization of both material and immaterial reproductive labor in the domestic sphere, the competition takes place between social robots and women in their capacity of caregivers and immigrant who, in many families, substitute the capacity of native women to care children, ill persons and elderly. The socio-economic model involved now is that of substitution of housework by social robots, even in its immaterial part. The premise is that social robots should cost less than migrant women although the performance might be lower in quality. This model should respond not only to the progressive unavailability of migrant women but also to the unsustainable model that would see the employment of a caregiver for each elderly.

In this section we also saw the problems connected with the penetration of the first wave of social robots in the domestic sphere. Firstly, some studies stress that social robots are addressed to specific niches of users. Secondly, other studies confirm that too much similarity to pets has to be discarded and thirdly it turned out that a new field of studies called human-robot-interaction has started. This new field of studies is identifying the communicative, emotional and entertainment model capable to describe the functioning of the interaction between humans and social robots.

UBIQUITOUS SOCIAL ROBOTING AND FINAL REMARKS

We saw in the previous section that social robots arriving in the domestic sphere have so far kept the traditional forms. These material forms will continue to exist because people prefer physical robots as transactional objects (Mataric et al., 2007). Mataric and her colleagues in fact report that the participants in their research have found that physical robots are more "watchful" and "enjoyable" than virtual ones. However the socio-technical system working in contemporary societies has opened new possibilities of conceptualization. The Robot Companions for Citizens (RCC) Manifesto (2012),[1] for example, reports two very interesting new conceptualizations: the first is "Robot suit," that is a wearable robot that provides support to people when moving and doing everyday life activities. The second is "Microrobots," that is "a class of intracorporeal robots for medical intervention, medical diagnosis or organ repair, substitution and functional regeneration, completely deployed inside the body" (The Robot Companions for Citizens Manifesto, p. 21). At the same time Timo Kaerlein (2012) argues that there is already some kind of robotic presence inside the new media such as the mobile phone. He analyzes, for example, a "cellphone-type tele-operated android" called Elfoid, which has been designed and produced to provide a substitute "for a dialog partner through evoking a feeling of presence" (Kaerlein, 2012, p. 1). Avatars such as SIRI in the iPhone or S-Voice in the Samsung Galaxy that work in the current mobile communication

[1] http:www.robotcompanions.eu
This website contains many useful information on this project leaded by Paolo Dario.

system as social agents also serve as examples. The help on the part of these avatars is still very limited and people have fun in getting them confused at the moment. However, they are merely the first step of a long journey that is occurring in the mobile environment. These presences, if developed further, can transform themselves in new modes.

A new, innovative model for social robots is possible: it is what I call, along the lines of the definition given by Mark Weiser of "ubiquitous computing," the invisible and ubiquitous roboting, which is the robot that exists without its own hardware. Within this process, robotic functions are separated from their electronic shells and social robots "weave themselves into the fabric of everyday life until they are indistinguishable" (Weiser, 1991, p. 94). In this case many people will use robots without being aware of it. This unaware use will avoid the elaboration of a specific attitude towards robots. The use of robots in this case is sucked inside the use of other media such as the mobile phone or the computer/Internet. As a consequence, the new technologies will become robotized in the sense that the presence of robots inside them will increase the automatization of communication and information processes, or, to put it another way, that social robots will be the new media.

The hidden and ubiquitous robot implies that robots must renounce their hardware. They will fertilize and strengthen the old and the new media with their software. It is the robot, whether it is an avatar or a social believable agent, that will work, in a saprophyte way, inside the already available technologies such as the mobile phone. This perspective is illuminated by two important papers: that of Sugiyama on mobile phones as quasi-social robots and that of Vincent on mobile phones as personalized social robots, both in this issue. In particular, these two papers highlight the notion of social robots as the combination of users and mobile phone. This hidden presence of robots has advantages and disadvantages. It can work well for all the areas of communication and immaterial labor, but it does not fit with users' needs when they have to do things or need a material, concrete help. Nevertheless, there is room for developing the invisible and ubiquitous robot, as this development accompanies and mirrors the disappearance of the human body from the communicative scenario.

To conclude, if we look at social robots from the perspective of the model of society they embody, their social meaning is not yet clear. Societal efforts seem to go in the direction of creating phantoms, simulacra, simulation, anti-authenticity, counterfeit, "as if" situations and processes, as Turkle stresses in her book *Alone Together: Why We Expect More from Technology and Less from Each Other* (2011). Do we think that an "as if" life is a social life enough and is this the way in which we like to organize the society of the future? Furthermore, the availability of an innovation such as that of social robots is not sufficient in itself to justify their production. It is necessary to quantify their costs in the short and the long run for the society in economic and social terms. This would also include the care staff required in order to pursue the effective application of a robot system, as Gelderblom, Bemelmans, Spierts, Jonker and de Witte underline (2010). It is also essential to articulate their goals, the target groups, and the environment.

Our societies need first of all to see themselves as organisms under change and then they need to establish limits and boundaries between automatized behaviors and free and creative behaviors. People need to make sense of social robots, to be aware of what it means to be working in glocal societies, to assess the environmental and social role of innovations, to include robotics in the production, protection and enhancement of territories, including houses, according to advanced ethical and aesthetical perspectives. However, at the same time, they do not have to be in need of social robots if this reduces the scope of the realization of human beings and if this impoverishes the search for meaning and fulfillment of human life.

Being at the beginning of a new phase, there are numerous future research questions that call for our attention. Why robots? What is a robot as technological artefact? What do robots represent to people? What is the relationship between people and robots? Who will be their owners? Why

should people buy (or not) them and what might be the social consequences? What might life and society with robots become like? What are the social needs or desires to which social robots answer? What are the economical, social, psychological and political motivations or are they technologically pushed? Do we really think that social robots will be able to answer profound and authentic emotional needs of human beings? And if so, in what way? Are there any alternative solutions to replace this growing presence of social robots, or perhaps, even a better solution? Answering these questions would be a good starting point for moving toward the next phase of our research efforts.

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