Impacto de Nuevas Tecnologías en la Cotidianidad: ¿Son los Robots Sociales los Futuros Smartphones?

Autor

MSc. Juan Giusepe Montalván Lume, jgmontalvan@pucp.pe
Pontificia Universidad Católica del Perú, Perú

RESUMEN

A juzgar por el actual desarrollo de la robótica social, se espera que pronto nuestra vida diaria se vea permeada por el uso de productos robóticos diversos. De hecho, según la actual definición de *tecnologías robóticas* por la Robot Japan Association, se podría decir que ya nos encontramos interactuando con sistemas robóticos complejos. Este es el caso de los smartphones, dada su cualidad de *asistente pasivo*, i.e., asistir al usuario en recordar deberes, agendar eventos, saber el clima, etc. Sin embargo, la pregunta no recae en si los robots serán o no parte de nuestras vidas, sino en saber si estaremos preparados para interactuar con ellos con conciencia y responsabilidad. En relación a esto, diversos académicos advierten posibles efectos preocupantes causados por el uso de estas tecnologías. Estudios en las ciencias sociales, psicología y diseño sostienen que el uso de smartphones y social media afectan el desarrollo de habilidades sociales y la construcción de identidades, y también advierten del surgimiento de fenómenos experienciales como el *Timelessness*. El presente estudio analiza estos escenarios en relación a las tecnologías robóticas y la robótica social desde diferentes perspectivas que incluyen al diseño, las ciencias sociales, la educación y las políticas públicas, para dar cuenta de la situación en la que nos encontramos frente a estos avances, y finalmente sugerir oportunidades de acción para los diseñadores.

Palabras Claves: impacto de los smartphones, robótica en la sociedad, políticas públicas, educación, diseño

Impact of New Technologies in Everyday Life: Are Social Robots the Next Smartphones?

Abstract

Judging by the current development of social robotics, our daily life is soon expected to be permeated by the use of diverse robotic products. In fact, according to the current definition of *robotic technologies* by the Robot Japan Association, it is possible to say that we are already interacting with complex robotic systems. This is the case of smartphones, given their *passive assistant* quality, i.e. assist the user in remembering duties, scheduling events, knowing the weather, etc. However, the question is not whether robots will be part of our lives or not, but whether we will be prepared to interact with them with awareness and responsibility. In relation to this, several academics warn of possible worrying effects caused by the use of these technologies. Studies in the social sciences, psychology and design argue that the use of smartphones and social media affect the development of social skills and the construction of identities, and also warn of the emergence of experiential phenomena such as *Timelessness*. The present study analyzes these scenarios in relation to the robotic technologies and the social robotics from different perspectives that include design, social sciences, education and public policies, to give an account of the situation in which we find ourselves in the advent of these advances, and finally suggest opportunities for action for designers.

Keywords: Impact of smartphones, Robotics in society, Public Policy, Education, Design

INTRODUCTION

Given that robotics and other cutting-edge technologies will be applied to a vast majority of products in the future, the day robotic products become part of human beings' daily lives does not seem anymore a scenario only possible in science fiction novels of visionaries like Isaac Asimov. At this moment in time, given the current robot technology development, the increase in demands of robots for the home, and yet the little research made in HRI Design and Social Studies in domestic robotics; we just can imagine the magnitude of the impact robots will have in human lives, society and culture.

With a new generation of personal robots that combine automation, social agency, and Internet of Things, the boom of robotic products for everyday life becomes imminent, and definitely will change the world, just as -or even further than- the personal computers and Internet in the last 20 years, and the expansion of smartphones in the last 10 years.

Being concerned about this, comes to mind the need to prevent that this great change takes us unsuspecting. It is necessary to get to a better understanding on how robotics will infer in our daily lives and influence user behaviors, lifestyles, environments and culture, in order to improve the design decisions and the effectiveness of policies and regulations.

Thus, this study is divided into two main sections: On the first part, focus is given to the current state of sociological and design research over the relationship between humans and technology since the computer era, and then, more specifically, to the evolution of human-robot interactions in the domestic environment. On the second part, the possibilities for improvement of the current design criteria, and policy making initiatives are explored regarding the personal social robots' development and the regulations for their inclusion in our society.

On Human and Technology

Human Relationship with New Technologies

On a revision of the history of American households' technological development since the 1700s, Ruth Cowan [1] discovered that technological achievements in the domestic space have tended to reduce men's household work, but not that of women, despite their explicit labor-saving purposes. She noticed that back in the 1850s, while three or four servants were needed in one household in order to attain a twentieth century's middle-class standard, only a fraction of the population could enjoy it. However, in the 1950s, technological advances and economic growth allowed a growing fraction of the population to enjoy such standards, reducing the number of people needed for such purposes while pouring all household responsibilities over the figure of the mother, thus exchanging capital for more housewife labor. Aligned with this, is the behavioral tendency to increase the *quality standards* of an activity once the effort required to carry it out have been reduced and made less unpleasant. And also importantly, social expectations and peer pressure over women's roles may have been as well intensified by the appearance of such "*labor-saving devices*", thus contributing to the raise of the standards for an average home.

From a behavioral perspective, through a review of the development of computing and social studies in technology since the mid 1980s with the objective of understanding how human intentions and technological artifacts are intertwined, Suchman [2] put into evidence how leading edge technologies are actually built on historical, traditional assumptions driven by people's existing schemas of how things should work. By observing Xerox printers' users who struggled to operate them, she discovered fundamental cognitive mismatches between the designers' intentions and the users' actual behavior.

From a social-psychology vantage point, based on an exploration of a broad spectrum of human interactions with technology and the meanings given to a variety of technological devices ranging from mobile phones to robots, computers, animatronics, and others with the

objective of understanding where technology is taking us and how society adapts to it. Turkle [3] raised concern about the implications of these technologies particularly on the younger generations, focusing on the way they learn to socialize. She stressed the term "authenticity" as to make a clear distinction between "*real world*" experiences and digitalized mimics recreated through the use of technology. To her, genuine, organic social interactions become degraded through constant exposure to illusory exchanges of meaning through the use of artificial intelligence. However, rather than entering the discussion over subjective valuations on real over digital, this study focuses on the place where Turkle's argument materializes into a tangible concern: the dynamics through which people learn to understand others, express their own ideas, and ultimately, understand themselves. The basis of this concern lays on the fact that the design of the digital platforms that allow humans to interact with others also allow users to adjust the *image of themselves* that they portray to the receiver, this space for editing and adjustment could be occasioning a gap or mismatch between the identities built over the digital and physical versions of the self. On the opposite side, when having face-to-face conversations with other people, there is no space for modifying, erasing, or tweaking the image portrayed to others, it happens instantly, and it is by showing these physical selves, that we learn important social skills, including understanding *who* we are.

The Impact of the smartphone

Adding to Turkle's propositions over the conflict between digital and physical experiences, research on smartphone overuse [4] have recently uncovered the qualities and characteristics of unplanned use, an actual common and widespread phenomenon about which little have been explored. Findings revealed unplanned use as being a preference for short-term gains over long term goals. Which, from a behavioral perspective, is caused by the user's unconscious desire for achieving more things in the same timeframe, however, only deviating into an illusion of 'busyness' characterized by fractured activities, volatile attention, and self-excused overuse. From an experiential perspective, it creates a diminished sense of the time spent, caused by actions not worth to be remembered, without clear purpose, and without contributions. According to the researchers, unplanned use is characterized by the quality of "*Timelessness*", which combines an illusion of being productive with a desensitization of the actual time, which appears to be a direct consequence of an ever accelerating life rhythm, generating anxiety towards filling the gaps between exposures of strong activity, so as to satisfy an illusory sensation of "*not wasting time*".

Human-Robot Interactions in the Home

On understanding the particular influence robotic products have on people that other devices lack, Jodi Forlizzi have been a major contributor and pioneer on the emerging field of social robotics. From a study comparing families using traditional vacuums and robot vacuum cleaners [5], she discovered that families using the robotic product cleaned more often, as well as making cleaning a concern for everyone in the home instead of depositing all the responsibility on the mother figure. Furthermore, the robot appealed to children and elders, adding a social aspect to the activity of cleaning. Family members reported watching it work together, played with it together, gave it a name, and talked to it. An important insight extracted from these results is that robotic products possess social agency qualities that create bonds of empathy with users which help break traditional stigmas over certain tasks and the people traditionally doing those tasks, as these products are not limited to their implied functional purposes of mere cleaning, laundry, mowing, etc. Although it is important to mention that this characteristic has cultural limitations. In a cultural comparison study between preferences regarding robotic products in the US, Korea, and Turkey, Lee and Šabanović [6] found that in both Korea and Turkey, mothers prevailed as the most common users, and furthermore, Korean participants preferred social robots to be under all means subservient to humans, reflecting the division of roles to be closely linked with social dynamics and hierarchies, aligned

with a collectivist and relational model of interaction, as opposed to an individualist and functional approach in the US.

Current market

Since previous work on robotic aimed primarily at technological achievement (ATR and MIT researches are prime examples), the focus tended to be almost exclusively on enhancing the skills and capabilities of robots from a developer's point of view, rather than giving importance to users' perspectives. This partly explains why there are few products that have succeeded in winning market popularity, despite that the cognitive and decision-making capabilities of robots have reached an acceptable level of complexity. To redress this issue, active efforts have been expended on the study of the social attributes of robots (e.g. Fong et al. [7]; Breazeal [8]; Dautenhahn [9]), though still few empirical/experimental studies have been performed in order to understand the actual nature of these social attributes and their importance [10].

Worldwide Trends

Many countries (e.g. Japan, South Korea, China, India, the European Union and USA) are competing to lead innovation in the robotic market. Researchers develop more complex robots not just for industrial purpose, but also robotic products capable of interacting with humans as assistants, social partners, guides, etc.

In 2008 four of the major Japanese robotic product companies (Tmsuk, ZMP, Vstone, and Business Design Laboratory Co.) joined efforts in a bid to create a mainstream market for robots and to stay a step ahead of rising competition from South Korea [11]. In 2016 the Apple and Samsung supplier, Foxconn, had replaced more than half of its workforce with robots [12]. And South Korean public officials have expressed their ambitions for achieving a human-robot co-existence society by the year 2030 [13].

With this scenario, it is just a matter of time until the robotic products' boom becomes a reality. In particular, the year 2017 appears as a critical moment due to the announcement of the release of the world's first family robot, JIBO, with thousands of pre-orders already made by costumers and developers. However, facing these rapid changes, it is important to maintain a social homeostasis, understanding society as a living, and constantly adapting entity, which reflects its qualities in our daily lives. "*This is why designers of robotic products are required to not only understand the social attributes of robots and the particularity of robotic interactions but also to thoroughly examine the various problems that may arise in the course of actual interactions between robotic products and their users*" [14].

Expectations based on the smartphone phenomena

Looking at the way we currently adapt to and use existing technologies can help to shed lights on the fundamentals of the interactions with future technologies. Given that upcoming personal robots are not just automated entities, but include IoT qualities that allow them to perform in many ways similarly to our current smartphones, it is a good starting point to observe and analyze the main differences and similarities that smartphones and personal robots possess. The current tasks that smartphones allow us to perform fit within the role of a passive assistant, meaning that the device only responds once the interaction has been initiated by the user, e.g. schedule meetings, be reminded of tasks to do, read mails, check the weather, order food, etc. However, robotic products possess particular social qualities that provide them with *agency* and *animism*. These qualities could facilitate the switch from a "*passive assistant*" approach to an "*active assistant*" type of interaction by providing the device with presence and personality. In fact, these are the kind of qualities that social domestic robots like Jibo promise to deliver, being able to intervene with suggestions in determined situations, drag our attention whenever an important message arrives, suggest dinner options, help as a *sous chef* providing relevant information while cooking, or turning off the lights in case you forgot to do so. Differently from

a smartphone, it would be able to participate actively of the social contexts and environments, whether it is as a photographer in a family reunion in the living room, or as a story teller in a kids gathering at the room. However, similarly as smartphones, they are not free from the possibility of over use, being the main concern over the children. Care given to a robot companion, compared to care given to a pet for instance, might loosen its boundaries as social robots become more common in homes. Yet, the main concern still remains on the possibility of children preferring to socialize with their robot companions, rather than socializing with other children and thus not learning human-to-human social skills such as tolerance, empathy, or team work.

The positive or negative influences of these new technologies will depend vastly on the joint efforts from robot design and development teams on one hand, in order to create robotic products that focus on human enhancement while avoiding misuse and bad practices, and in the other hand, from policy makers in order to raise awareness and promote the responsible use of robotic products among users, which could be part of the educational curricula at schools.

Possibilities for Improvement

A Robot Design Closer to Humans

Thanks to advancements in robotics technology and academic research, and the growth of the robotics market brought on by rising demand, robotics is moving beyond the realm of engineering and becoming an active field of research in the humanities and social sciences. Robot design, in particular, is gaining increasing importance as a means of presenting robots, commonly regarded as techno-centric hardware, to new users as daily products that combine communication media with services suited for everyday life [10], this means to *humanize* robots focusing on the final user.

To achieve this from the design research perspective, first it is required to establish the basic general principles for social robotic product design, which begins from a user approach. As a first step on this path, a user-centered theoretical and methodological framework for design researchers in the field of Human-Robot Interactions (HRI) was created by KAIST researchers in 2011 [10].

By employing this framework, along with other related studies as a base point, design researchers are now able to determine user needs and expectations in accordance with stablished design approaches and qualities of robotic products; as well as to determine the influence of users within domestic and public "*product ecology*" [15] environments. In other words, they are able to determine **what people will search in robotic products and why**, as to provide designers with lights on how people's everyday lives will probably look like when robots become part of our daily lives.

Moreover, it is important to notice that the design process of robotic products is different from other design areas because many of the robot's characteristics, like autonomous recognition, perception, and actions, and their effects on user behavior are different from generally existing products. For a product designer, the entire robot design process is divided into three basic elements: character design, appearance design, and interaction design [16], and these three elements are based upon the five properties of social robots that include form, modality, social norms, autonomy, and interactivity considerations [17]. However, interaction design (one of the three elements of robot design mentioned above) tends to be weighted over the other two elements, and interaction-related factors such as modality, autonomy, and interactivity figure prominently among the five properties of social robots. Thus, product designers working in robot design cannot only be proficient in the realm of appearance design, but also should develop a solid grasp of the more fundamental issue of the interaction between Humans and Robots [10].

Designer role in Human-Robot Interaction (HRI)

Human-robot interaction is traditionally understood as the design, evaluation and implementation of systems that enable the exchange of information between humans and robots. This includes the affordances (i.e., the functionalities that can be inferred from an object) a robot can provide, e.g. ask for information in Internet, check your mails, watch videos, etc. and the way how these activities are performed, whether by using voice commands [18], augmented reality [19], or others.

Research on interactions between humans and robots can be seen from two major perspectives [20]. The first is robot-centric research on interactions. This is how robotic engineers view HRI; most robot-centered studies focus on robots' perceptions and cognition of humans and related actions. The second perspective for research is **user-centered interaction**, which focuses more on how humans perceive and cognize robots and how they act during their interactions with them rather than on how robots view humans. This is research on interactions from the perspective of robotic product designers rather than that of robot engineers. These designers study emotional bonds or feelings that users develop using robots in the real world, these robots penetrate humans' daily lives more deeply than other products and bring about various changes in their lives.

Based on the graduate curriculum of the Robotics Institute at Carnegie Mellon University, the three research elements of robotics engineering are: 1) sensor technology, which allows a robot to perceive its external environment; 2) AI technology, which enables a robot to cerebrate using the wide-ranging information and knowledge databases thus perceived, and to autonomously control its various components; and 3) actuator technology, which endows a robot with mobility and the capability for action. When these research elements are mapped onto the cognitive process humans carry out in response to their environment [21], sensor technology corresponds to 'perception', AI technology to 'cognition', and actuator technology to 'action'.

Towards a Human-Centered Design for Robotic Products

The design approach of Human-Centered Design (HCD), focuses on understanding the needs and abilities of those who are to use the system, be it a physical product, software, or the combination of both; and consider them as a major subject in the design process. Since then, usability and understandability of products has indeed been improved.

A fundamental corollary to the principle of Human-Centered Design has always been that tools adapt to people, not people to the tools; however, in recent years this theory has started to be questioned by including the time dimension into the equation, allowing to think of humans as non-static users, and that change over time along with the cultural, social, technological, economic, political and more recently environmental variables of their context. The recent historical record contains numerous examples of successful devices that required people to adapt to and learn how to use them. People are expected to acquire a good understanding of the activities to be performed and of the operation of the technology. This means people also adapt to the tools they choose in order to perform their activities as these tools become more complex and 'smart' (examples go from objects already assimilated as cars and watches, to objects being assimilated like smartphones, smart TVs, tablets and future smart products like robots).

In response to this, Norman created the Activity-Centered Design (ACD) approach, being more of an actualization of the HCD principles, which gives two possible explanations why people also need to adapt to tools, and indeed they do; one is the activity-centered nature, and two the communication of intention from the builders and designers. Successful devices are those that fit gracefully into the requirements of the underlying activity willing to be realized, supporting them in a manner understandable by people. Builders and designers often have

good reasons for the way they constructed the system. If designs make users naturally understand these reasons, then the task of learning the system (learning curve) is both eased and made plausible.

HCD asserts as a basic tenet that technology adapts to the person. In ACD, is understood that much of human behavior can be thought of as an adaptation to the powers and limitations of technology. Everything, from the hours we sleep to the way we dress, eat, interact with each other, travel, learn, communicate, play, relax, etc. Not just the way we do these things, but with whom, when, and the way we are supposed to act, variously called mores, customs, and conventions. An understanding of people is still a part of ACD, but it also requires an understanding of technology, the tools, the activities, and their reasons.

Building Policy for Robots in Society

Researchers at the Ministry of Interior in China, and the National Chiao Tung University in Taiwan [13] studied major robot developments in Japan and South Korea as regulators from these countries have claimed that by the year 2030, robots should be capable of adapting to complex, unstructured environments and interacting with humans to assist with the performance of daily life tasks. Similar to the current IT industry, individual firms will specialize in such areas as education (public, safety, technical, etc.), selling insurance to cover special robot risks, and buying/selling used robots. The authors name these future robots as Next Generation Robots, and introduce the concept of Safety Intelligence as part of a framework for a legal system that focuses on safety issues looking towards the emergence of a **Human-Robot Co-Existence Society**. Within the Safety Intelligence concept lay two dimensions, the first involving ethics, by proposing a “Third Existence” status for robots and a recommended ban on equipping Next Generation Robots with Human-Based Intelligence. And the second involving the elaboration of a Legal Machine Language designed to resolve issues associated with risk caused by unpredictable interactions in unstructured environments (framed as Open-Texture Risks) as part of an emerging field of legal research referred to as Robot Legal Studies.

However, how can we determine if a society is ready to include robots as equals? At first glance this question appears too vast to be answered, however, we can identify certain hints that can tell us about the predisposition of a society towards an element in concrete, be it robots for homes in this case.

In a study conducted by Jennifer Robertson in Japan [22], she identified Japanese nationalism and xenophobic attitude as a strong stream which pushes the Japanese society towards looking for internal solutions to their social problems including the well-known aging society issue, the reduction of the work force and the difficulties for socializing reflected on high rates of loneliness.

In the American case, there seems to be a concern on robots that resemble too close to human beings. Without getting too far into ‘uncanny valley’ issues, the mere anthropomorphic configuration of the robot creates rejection concerning it being able to replace humans on various contexts, possibly taking away jobs from them. When the worldwide famous anthropomorphic robot Asimo, was presented in an advertisement by Honda showing the robot as part of the family members on their campaign for introducing Asimo to the American market, it was highly rejected by that audience argumenting that they didn’t like the idea of robots as a replacement for humans, and their jobs. It is interesting however that, with the announcement of Jibo, which is a small social robot with a body without extremities and a rounded head, to be released to the market on 2017 as the world’s first family robot, the public acceptance was immediate, making a highly successful campaign on Indiegogo, the startups crowdfunding platform where the project was first announced.

In addition, in a study conducted by Lee, et al., [23] on cultural differences between Korea and US regarding initial conceptions and expectations on domestic robots, the researchers

discovered that Koreans tent to conceive humanoid shapes as the standard for a domestic robot while Americans have a functionalistic approach

The previous examples put on evidence how important it is to consider the cultural background and people's imaginations over robots in order to elaborate feasible policies and regulations for their inclusion in society. Strong cultural variations among countries will directly influence over the consideration of societal goals and even the understanding of certain condition as being a positive impact to people.

Current Robot Policy initiatives

Worldwide, the leading countries in robot technology after Japan, as depicted by the Japan Robot Association [24] include the European countries involved in robotics R&D, US and Canada. These countries share rather similar approaches to robot development compared to Japan. And the criteria for the rating was based on the following aspects:

1) Ability to develop unique products that are subsequently copied by other nations.
2) Ability to export.
3) Ability to have a domestic market larger than other countries.
4) Ability to create markets.

Furthermore, the Japanese Robotics Association recognized that Japan has lost competiveness on the creation of new innovative markets while mainly focusing on perfecting the traditional industrial robots market, which could be related to the companies' rigid organizational culture which doesn't give much space to disruptive approaches and the creation of new smaller markets. On the other hand, we can observe that European robot developers fall behind their peer on robot development for entertainment, which is one of the current markets with higher expected growth rate according to the Japan Robotics Association.

Another element of concern regarding robot development is the lack of fluid communication between companies and research centers which in turn creates a mismatch between the new technologies being developed and the industry requirements. In order to solve this problem and allow a fluid technology transfer from research institutions to the market, the Headquarters for Japan's Economic Revitalization [25] has envisioned an "open innovation" system where the government, the research institutions and the companies openly collaborate through sharing of technology and information while stablishing a set of standards and normalizations that will allow an easier and faster technology transfer.

CONCLUSIONS

Judging by the current trend of events, it won't be long until we are surrounded with robotic products, indeed we already are, according to the current definition of robot technology by the Japan Robot Association: "any type of autonomous procedure of a task be it physical or virtual is considered to have robotic qualities" as mentioned on their Summary Report on Technology Strategy for Creating a "Robot Society" in the 21st Century [26]. Based on this, we could say that we are already predisposed towards interacting with autonomous, complex systems.

But, the matter is not whether or not robots will become part of our lives but rather if we will be able to handle it with enough consciousness and responsibility. Related to this point, Turkle [3] presented clear opinions against robots or other current technologies replacing human contact based on her observations of current smartphone and social media use. Furthermore, studies on smartphone overuse have shown empirical evidence of a possible negative consequence framed as "Timelessness". Paradoxically, the Headquarters for Japan's Economic Revitalization sees on future personal robots a powerful solution for Japan's main concerns including their social issues, especially regarding aging society and loneliness.

From the design perspective, the trend of user experience design approach is reaching the robot design field, as only user experience insights allow us to determine if all parts of the system, in this case all the elements involved in the interaction between the robotic product and the user, worked well as a whole (holistic view). But for this to actually be accomplished, in a suppose-to-be multidisciplinary field as robotics, it is necessary a director that envisions – designs- how should be the resultant experience (design direction), and for this task, designers have the predisposition as they focus on user insights in order to improve their quality of life and indeed the creation of new lifestyles. Unfortunately, current robot development is dominated by the engineer domain, leaving minimum space for multidisciplinary cooperation.

Also form the policy and regulations point of view, there is a clear intention from certain governments to support the robot industry by providing the companies that develop robotic products and the designers in them, tools to design competitive robots in the market through policies that promote open collaboration between the government, the robotic companies and the research institutes, accelerating the process of new robots' development to be able to face consumer expectations over time. However, as currently happening with smartphones, design plays a crucial role in delivering positive or negative outcomes from the use of these technologies due to the decisions taken into the configuration of the interaction themselves, and thus design too should be contemplated within public policies. As Heather Knight [27] put it, "Regulations encouraging and safeguarding good design will influence whether users will want to keep humans at the helm, as in telepresence systems, join forces in a shared collaborative environment, or hand over the decision making while riding in an autonomous vehicle."

Finally, from an educational and labor perspective, robot design will be expected to become a demanded professional profile within the industry of robotic products, and universities would require specialized academic material as guides and manuals to provide future professionals with design criteria within the robotic field. "There will be new profiles to fuel this industry, such as mechanical engineers with expertise in psychology or designers of interfaces between robots and humans" as Raul Suarez, director of robotics research at the Polytechnic University of Catalonia explains to the Spanish Newspaper El País [27].

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