Roboticists' Imaginaries of Robots for Care: The Radical Imaginary as a Tool for an Ethical Discussion. Núria Vallès-Peris & Miquel Domènech

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Abstract

In this paper we analyse imaginaries about care robots using a set of interviews with roboticists. The study of imaginaries—from a notion close to that of Castoriadis's radical imaginary—is used as a tool to unravel ethical, political and social concerns that care robots entail. From the analysis of the interviews, our results highlight that imaginaries regarding care robots are predominantly sustained by a social process of care fragmentation. The translation of the imaginary of industry robots into the wildness of the daily life in healthcare reconfigures the comprehension of robots and their mediations. This process is intensively linked to Human Robot Collaboration (HRC) and Artificial Intelligence (AI) imaginaries of care, based on the cult of domesticity and the opposition of human caring to rational caring. We see how these fragmentations are in tension with an approach that seeks to integrate the ethics of care with technoscience, which has relevant consequences for the ethical debate on care robotics and the political significance of care in our world.

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Introduction

Over the last decade, the number of projects and publications about robotics has grown considerably, particularly those related to medical care[1]. Pilot test or research studies involving artefacts with names like "care robots" or "assistive robots" are being progressively introduced into hospitals and other healthcare environments, particularly targeting the most vulnerable groups such as children or the elderly[2]. In these settings, care robots are used in therapeutic interventions with, for example, autistic children[3] or in rehabilitation processes[4]. They are also involved in the extensive line of research and application of technologies to reduce pain and anxiety in paediatric settings[5]. Particularly prolific are the studies with pet robots that are used to make hospital stays more pleasant[6], as companions for the elderly[7], or for monitoring or support in cases of dementia[8].

This process was preceded by an intense debate on the ethical and social implications of introducing robots into everyday healthcare environments. In this paper, we analyse roboticists' imaginaries of care robots, using them as a tool to reflect on ethical and social controversies. Based on a set of in-depth interviews with roboticists, we discuss some of the implications of introducing care robots into daily life. We employ a notion of ethics which is closer to politics and seek to discuss what is good for people and the common life[9]. From this approach, we use the study of imaginaries as a way to grasp the roboticists' conceptions of care and care relations which are entangled in care robots, thus enabling a discussion of the social and ethical implications that these conceptions entail. When roboticists design a care robot, they also imagine the caring relations embedded in the artefact, as well as follow certain ideas of care which are part of the way roboticists see the world.

The Radical Imaginary as a Tool for the Ethical Study of Technologies

Over the last few decades, there has been a growing literature in Science and Technology Studies (STS) that has researched the imaginaries associated with science and technology from a plurality of approaches[10]. Sheila Jasanoff and Sang-Hyun Kim's is probably the most relevant. According to them, sociotechnical imaginaries are "collectively held and performed visions of desirable futures (or of resistance against the undesirable), that are also animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology"[11]. Research in STS shows us that imaginaries are embedded in the practices and the organization of technoscience[12], shaping the trajectories of innovation and development[13]. At the same time, these imaginaries are not only linked to particular

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[1]Stahl and Coeckelbergh, "Ethics of Healthcare Robotics".
[2]Heerink et al., "New Friends: Social Robots in Therapy and Education".
[3]Ibid.
[4]Broekensand Rosendal,"Assistive Social Robots in Elderly".
[5]Coninx et al., "Towards Child-Robot Interaction".
[6]Díaz-Boladeras et al., "Assessing Pediatrics Patients".
[7]Jenkins and Draper, "Robots and the Division of Healthcare".
[8]Preuß and Legal, "Living with the Animals."
[9]Castoriadis, *Hecho y Por Hacer. Pensar La Imaginación*.
[10]McNeil et al., "Conceptualizing Imaginaries of Science".
[11]Jasanoff and Kim, "Sociotechnical Imaginaries", p. 19.
[12]Fujimura, "Future Imaginaries".
[13]Ibid.

research projects; they are imbued with an implicit understanding of the social world[14]. This is a not a linear process, but a process of negotiation and conflict between different imaginaries[15]: imaginaries about ways of comprehending the world, about the artefact itself, and about the relationships entangled in it. Also, in the field of robotics, negotiating imaginaries is an important part of the work done by those involved in the development of robots, i.e., the roboticists[16]. If we assume that the imaginaries of care are part of the assemblage configuring the role of robots in human action, and that the discipline of ethics seeks answers to questions regarding how to act[17], then we must take these imaginaries of care as a relevant issue for the ethical debate on care robots.

In this vein, as other authors have proposed, we take imagination as a source of reflection for the ethical debate, as a tool to contest the instrumental reason that dominates the technological debate[18]. With this objective, our proposal is based on Cornelius Castoriadis's conceptualization of the radical imaginary and its role in the emergence of newness[19]. For Castoriadis, creation is always ex-nihilo, it consists of bringing into existence new forms of being that were not there, that cannot be sufficiently explained by preceding historical conditions. Of course, this creation always occurs in specific social and historical conditions, this is why the social imaginary is composed of two irreducible poles that cannot exist without each other: the instituted imaginary, which is the result of a socio-historical process; and the instituting imaginary, from which new creations are made.

Castoriadis understands society as the result of a socio-historical process of instituted imaginaries. Instituted imaginaries give meaning to and hold together our society, sustained in a network shaped by language, norms, family, tools, the way we do things, artefacts, etc. Nevertheless, despite being made by society and living in it, individuals have the capacity to make and remake the instituted society, because individuals and society have the capacity to create new things.

We have based our analysis of roboticists' imaginaries on this tension among the instituted and the instituting dimensions of the imaginary, which is entirely pertinent in dealing with technological innovations. Indeed, the locus of creation of any artefact is the socio-historical field. The socio-historical conditions of its emergence have to do with the diverse biases, values or power relations that have been inscribed in the artefact. Thus, the artefact is the materialization of the instituted socio-historical imaginary, finite and limited by its substances. At the same time, artefacts are also indeterminate, because of the capacity of imagination to create what is not there. We can grasp new meanings, new practices, and new relationships that are inscribed in every artefact proposed to society.

The main contribution of the radical imaginary to ethical discussion, as compared to other notions of the imaginary, lies in its creative capacity. It is because there is radical imagination (and not only simple reproduction or reformulation) and because imagination is not limited to already known forms, that there is reason for hope[20]. Even in the context

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[14]Wynne, "Public Participation in Science and Technology".

[15]Shatzer, "A Posthuman Liturgy?".

[16] See note 12 above.

[17]Verbeek, "Materializing Morality: Design Ethics".

[18] Camps, *La Imaginación Ética*.

[19] Castoriadis, *La Institución Imaginaria de La Sociedad.*

[20]Castoriadis, *Hecho y Por Hacer. Pensar La Imaginación*.

of growing commodification, imagination represents a space of divergence and complexity, a source of resistance and antagonism, of denial and potentiality[21]. Applied to the analysis of the ethical controversies surrounding care robots, the radical imaginary allows the articulation of forms of reflection that assume the contingency of human action and, therefore, do not deny the contingency of care robots. It offers a conceptual tool to open ethical reflections that go beyond the limits of existing debates in ethics and robotics, based on a technocratic logic and particularly focused on functionalities[22].

Confronting the Dominant Imaginary with the Ethics of Care

Our aim is to think differently and develop a debate on what lies beyond the limits of what is established. "Thinking differently", from our ethical proposal, has to do with placing at the centre of the ethical debate on robots the idea of achieving a good life in common and the discussion about what makes us feel good, both as individuals and collectively. In this paper, we study the ways of understanding and imagining the relationship between care and robots, bringing into conflict the dominant imaginary, dominated by the market and the idea of technological advance as a form of progress[23].

In the study of the imaginaries around robots, we confront the dominant imaginary (with which the robot is entangled) with the proposal developed from the standpoint of an ethics of care, which seeks to guarantee the good life and the common good. Since the publication of Carol Gilligan's *In a Different Voice,* a vast number of pages on ethics of care have been written[24]. From the multiple approaches to the ethics of care, we depart from the perspective developed by Joan C. Tronto, that seeks to understand care from political philosophy.

Tronto's approach to the ethics of care is defined by a set of core conceptual issues: (a) The starting point of the human is relational involvement with others, in a network of relationships in which each individual has to reconcile different forms of caring responsibilities. The ethics of care emphasizes relations and responsibilities instead of focusing on rights and duties[25]. (b) The morality of care is bound to concrete situations rather than being abstract and based on principles[26]. The analysis of the processes of care (that involves caring about, caring for, caregiving and care receiving) provide us with a useful guide for thinking about how we do a particular caring work and its ethical dimensions[27]. (c) While care work is gendered, ethics of care can be described as a proposal to de-privatize and de-genderize the notion of care, that elevates care to a central value in human life with the aim of transforming the moral boundaries surrounding care[28].

Widening the ethical debate centred on the analysis of risks and applications in robotics[29], which often takes a highly speculative form[30], we would like to introduce to

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[21]Haiven and Khasnabish, "What Is the Radical Imagination? A Special Issue."
[22] Verbeek, "The Struggle for Technology."
[23]Castoriadis, *Una Sociedad a La Deriva.*
[24] Gilligan, *In a Different Voice"*
[25] Sevenhuijsen, *Citizenship and the Ethics of Care.*
[26] Cockburn, "Children and the Feminist Ethics of Care."
[27] Tronto, "An Ethic of Care."
[28] Tronto, *Moral Boundaries*.
[29]Verbeek, *What Things Do*.
[30]Šabanović, "Robots in Society, Society in Robots."

such debate the discussion about the conceptions of caring and the caring relations entangled in the robot.

Materials and Methods

Our paper is based on the interpretative qualitative analysis of eleven interviews with roboticists designed to explore their care-robots imaginaries. Through the analysis of imaginaries, we explore how care is conceived and how it is produced in the design and development of care robots.

The selection of interviewees was not random; the sampling strategy that was applied was designed to obtain a relatively "homogeneous" group. Thus, we interviewed a set of roboticists—according to the Collins English Dictionary, "a specialist in robots or robotics"[31]—working in the field of care robots: either engineers developing care robots or other professionals who were working together with engineers in the development of care robots, such as physicians, lawyers or philosophers. Eleven roboticists from Spain were interviewed, out of which: nine were men and two were women; six were professionals in the field of STEM, one in the field of health, and four in the field of social sciences and humanities; six worked in the private sector and five in public universities.

The list of interviewees is as follows:

- One philosopher, expert on social and care robotics, head of a research group, male. *Roboticist 1.*
- One mathematician, expert on social and care robotics, head of a research group and a university unit on robotics, male. *Roboticist 2.*
- One engineer, expert on care robotics for the elderly, head of a research group and a university unit, female. *Roboticist 3.*
- One physician, head of the innovation unit in a children's hospital where robots have been introduced, male. *Roboticist 4.*
- One computer programmer, expert on educational robotics, head of a research group and a technology innovation company, male. *Roboticist 5.*
- One physicist, expert on care robotics for the elderly, head of a research group and a robotics company, male. *Roboticist 6.*
- One engineer, expert on care robotics, head of a research group and a foundation devoted to robotics for vulnerable people, male. *Roboticist 7.*
- One engineer, expert on care robotics, teacher and developer, male. *Roboticist 8.*
- One engineer, expert on artificial intelligence, head of an artificial intelligence research institution, male. *Roboticist 9.*
- One teacher, expert on care robotics, therapist and developer, head of a private institution's robot implementation unit, female. *Roboticist 10.*
- One lawyer, expert on social robotics, researcher, male. *Roboticist 11.*

Virtually all of them (except one) were senior professionals leading research projects and/or research & innovation units on robotics for care. The ages of the interviewees ranged from thirty to sixty years old. All of them signed an informed consent where the whole project and its goals were specified, including the objectives of the interviews and the confidentiality and anonymity of data, among other aspects. With this consent, all interviews were recorded and transcribed.

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[31] *Collins English Dictionary*. Modified entries © 2019

Interviews were conducted face-to-face; they lasted for 1 hour approximately and they were semi-structured, meaning that both the interviewee and the interviewer had considerable freedom to direct the course of the interview. The data reported in this paper come from conversations arising from the following initial questions: What is a care robot? What are their potentialities for medical/social/educative care? How do you imagine care robots in the future? Do you think that this could happen? What could be the main risks in this future scenario? What fears do you have regarding care robots? What could be the main benefits of introducing care robots in the future? What would be the most desirable future for you regarding care robots?

Translating the Industrial Model into Care Relations

Taking into account the dialectics between the sociohistorical and the creative dimensions of imaginaries, it is possible to show how artefacts contain the representations and projections of their design process, through which the diverse biases, values and relations are incorporated into the artefact and configure certain forms of relationship. When roboticists design a robot, the way of thinking the relationships that the artefact enables happens in an implicit way; roboticists design appearances and functionalities in "their mind" (in their imagination) without explicitly aiming to configure caring relations. However, this process entails a particular way of understanding the world, what is good or bad, what is necessary and what is not; roboticists incorporate a set of moral values about care relations in the robot. Paraphrasing Peter-Paul Verbeek, this implies that roboticists are doing "ethics of care by other means"[32].

Based on our interviews, we analysed the various biases, values and representations, that guide the design of a device in connection to care. This process departs from a representation of the translation of an industrial model into care relations:

"I want to say that I do hope that, as in industrial robotics, basically, this type of job has been replaced. In English, they call it the triple D: Dirty, Dull and Dangerous, right? Well, it's clear now we have moved to a social environment [the development of robotics], because the tasks that we want the robots to replace are like this, boring tasks, dirty tasks ... well, dangerous ones, or maybe less. But in any case, they keep the caregiver there free from these routine tasks." Roboticist 3

"*This type of job*" to which Roboticist 3 refers has to do with the tasks of disabled people's caregivers at a residential home or a day-care centre. The research group of Roboticist 3 was developing robots with manipulation-related skills in close human-robot interaction—such as dressing or feeding somebody—that could be flexible and adaptable to the user. In this part of the interview, we were talking about a robotic arm for spoon-feeding purposes in which the research team was working in close collaboration with a residential home for people with severe disability. In our quotation, "*the job to be replaced*" was the caregivers' job of spoon-feeding patients. This task was associated with the tasks performed by industrial robots conceived for doing Dirty, Dull and Dangerous jobs, the triple D. As expressed by the idea of the triple D applied to care robots, the concept of industrial robot is also used in a daily life environment.

According to the *International Federation of Robotics*[33], historically robots have been used mostly in industrial environments, where they have been introduced in accordance with the logic of work automation and optimization of production lines. In

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[32] See note 17 above.

[33] IFR, "World Robotics/Statistics & Resources."

such environments, the concept of an industrial robot statically placed in a cell and continuously repeating a carefully predefined sequence of actions has remained practically unchanged for many decades[34]. The translation of the idea of industrial robot into daily life contexts has to do with the transformation of the daily domain of care. That is, to adapt it to the productive logic in which industrial robots are conceptualized. This translation entails two notions that configure the imaginaries embedded in care robots, namely: on the one side, that robots are conceived for replacing tasks that were previously being performed by humans, and, on the other side, that these tasks have some particular character that makes them morally delegable. In the translation process, workers become caregivers and manufacturing tasks become care-giving tasks. These imaginaries are splendidly encoded in the transcribed fragment, where Roboticist3 explains the tasks that the research team wants their care robot to develop: "*the tasks that we want the robots to replace are like this, boring tasks, dirty tasks.*"

However, as stated by the International Organization for Standardization (ISO)[35], there is a considerable variance in the types of industrial robots, depending on the level of contact between robot and worker. At one end of the technical spectrum are traditional industrial robots statically placed in a cell and continuously repeating a carefully predefined sequence of actions. At the other end of the spectrum are industrial robots designed specifically to work alongside humans in a shared workspace, known as collaborative robots[36]. As stressed by research about the role of robotics in manufacturing, the growing demand of collaborative robots is simultaneous to the growing demand for high productivity levels requiring more product variation, small life cycles and smaller batch sizes[37]. These industrial scenarios require short task-execution times and faster/easier robotic programming methods that can be carried out by factory workers and enable safe, flexible, modular and adaptable robots to perform different production requirements[38]. In this framework, the approach of human-robot collaboration (HRC) is gaining more relevance in industrial production[39].

The emergence and development of the HRC approach is highly relevant for the translation of the imaginary of manufacturing robots to caring, because it nuances roboticists' imaginaries of care robots, integrating collaboration among humans and robots. Together with the imaginaries of machines replacing human tasks and of morally replaceable tasks, the possibility of having safety robots working in collaboration with humans is also part of the process of conceiving robots into daily life.

Continuing with the subject of the development of robots with useful skills for tasks related to the feeding of people, another one of the roboticists interviewed was working on a robot that would bring food from the kitchen to the dining room and distribute it among the tables. The robot, which was still in a very preliminary phase of design, was used in a pilot test in a residential home for people with severe intellectual disability. However, as it was too rudimentary and the patients in the residential home were not accustomed to a foreign object circulating around the dining room, the robot was being

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[34]Pedersen et al., "Robot Skills for Manufacturing".

[35] The International Standard ISO 8373:2012 specifies vocabulary, definitions and explanations about "Robots and robotic devices".

[36] IFR, "Demystifying Collaborative Industrial Robots."

[37]Dean-Leon et al., "Robotic Technologies Industrial Robot".

[38]Ibid

[39]Fryman and Matthias, "Safety of Industrial Robots".

tested in the warehouse at the residential home, where it did not interact with anyone and did not carry anything around. Regardless of the difficulties of the pilot experience with the robot in its preliminary phase, the HRC approach was the one guiding the conceptualization and design of the robot. Grounded in the need for safe, flexible, modular and adaptable robots[40], HRC enables —and is enabled by—an imaginary of humans and robots working physically together at the service of specialized and personalized demands. As it was expressed in the interview with the roboticist responsible for the project of bringing food from the kitchen to the dining room tables:

"We always think of it [the robot] as a support tool so that workers can be released from certain tasks, so that they can provide more personalized attention." Roboticist 7

A robot "*as a support tool*" is a device that one can work with, in collaboration. At the same time, HRC is the approach linked to the personalization or customisation of products as a way to meet the challenges of the new industrial paradigm, which requires product variation and small life cycles[41]. In the process of robots' translation from production processes to daily life, personalization is one of the imaginaries embedded in the robot. It is implemented by making it possible to adjust the robot's performance to the needs of each user/patient, as well as to adjust the performance of the caregiver working in collaboration with the robot to the needs of each user/patient. As we could see in the preceding quote, the idea of working in collaboration with the robot is associated with the personalization of caring processes: "*that they [caregivers] can provide more personalized attention."*

As we have seen in the preceding paragraphs, it is from the industrial setting that roboticists take their examples, metaphors or images to explain what a care robot is and should do. It does not mean that they are suggesting that care robots are a simple development of industrial robots. However, this extensive use of images from the industrial setting has at least two effects:

(1) In the first place, the reproduction of the logic of the assembly line and the new processes of short cycle and flexible production. This is supported by the development of the HRC paradigm, which makes it possible to imagine a robot collaborating alongside a human being.
(2) Secondly, the need to take into account the realm of everyday life, a messy and uncertain environment far from the ordered and predictable life of the factory and the assembly line. This implies attending to the potentialities offered by AI technologies.

These implications are enacted in care-robot imaginaries. The imaginaries related to the first one are developed in the following section about the "cult of domesticity". In the section entitled "The robot in daily life wildness", the roboticists' imaginaries mobilized in the second one are dealt with.

The Cult of Domesticity Embedded in Care Robots

The representation of an industrial robot relocated to the domain of care is accompanied by a certain way of imagining care relations and viewing care. All the roboticists that were interviewed agreed that the aim of delegating tasks to robots was to free caregivers—or humans in general—from heavy, dirty and repetitive tasks. Caring

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[40]See note 37 above.
[41]See note 34 above.

tasks that could be replaced, and thus could be delegated to robots, are those ones related to physical effort (such as lifting patients out of bed, helping them with rehabilitation exercises, etc.) and those ones that we shall summarise under the category of "daily assistive tasks" (such as feeding, bathing, giving medication, remembering instructions, etc.). In care, these daily assistive tasks are considered "mechanical" and repetitive tasks that, in the manufacturing world, were assumed by industrial robots to free workers from triple-D tasks.

When a robot, or any other technology, is introduced into a health context, the people involved in caring processes establish links with the artefact because it becomes embedded in the assemblage of care relationships in such a health context. Technologies enable certain relationships between humans and the world that would not have been possible otherwise. However, in performing this role, technologies are not neutral intermediaries, but actors actively influencing the formation of human perceptions and their interpretations of the world[42]. A robot thought of as a mechanical arm to spoon-feed a person with severe disability is accompanied by specific forms of use—for example, a certain way of organizing the dining room, its tables or chairs—and is conceived to generate certain behaviours on the part of its users; of course, caregivers and care-receivers will have different interactions and relations at mealtime depending on whether we introduce the robot for feeding or we do not.

Continuing with the example of the roboticists developing robots for feeding, in the quotation below we reproduce a part of the conversation about the imagined organisation of meal times after the introduction of robots for feeding in a residential home for people with severe disabilities, specifically with paraplegia and tetraplegia.

"It would be fantastic for us if caregivers could devote themselves to giving conversation at meal times, if they were there for covering the affective part and not for spoon-feeding people […]. If we had a machine capable of giving food to each person... not an arm, a simple thing, then we could engage in conversation. Of course, this requires for robots to realize when a person is talking, for example, and see that his feeding does not interfere with the conversation. [...] I think we have to train public opinion to go in this direction [...] Machines, robots… we free humans' time to have more quality time devoted to the sick, that is, to replace routine, repetitive jobs that, in general, we humans do not like to do either. To do this, to spoon-feed a patient, because... The patient also feels badly many times. Instead, if it were a machine, it gives more autonomy and the person, the caregiver, can devote more time to quality care, right?, to have creative interaction." Roboticist 3

The way roboticists imagine the delegation to robots of tasks connected to feeding configures a set of possibilities of relationship with care robots and, at the same time, it implies a certain imaginary about what care is like, about how to organize it and about how to manage it. On this basis, roboticists' imaginaries will influence or modify the assemblage of care relations in which the robot will be introduced. Care robots make sense when they are integrated into a network of relationships. For this, it is considered that they are defined on the basis of their integration into care practices, highlighting their relational and contextual nature. Care robots "are" characterized by being introduced into therapeutic relationships to meet the care needs of those providing care or, directly, of the recipients of care, as well as by their use in daily healthcare settings such as hospitals, nursing homes, hospices or homes[43]. Thus, if we understand care robots as embedded in an assemblage of care relationships and, at the same time, as modifying the interactions

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[42]Latour, *Pandora's Hope.*; Verbeek, "Materlializing Morality: Design Ethics"

[43]Van Wynsberghe, *Healthcare Robots. Ethics, Design*.

and relations throughout the assemblage, then it would be strange for us to focus the ethical debate only on the artefact. For this reason, the robot is not our privileged actor for discussing care robots, because it configures relations and shapes human behaviours and experiences as it is enacted and appropriated in the contexts and relations into which it is introduced.

As has been explained, with the translation of the robot from the industrial to the care domain, the imaginary about care robots is grounded in a process of care fragmentation: care is conceptualized as a set of tasks that can be separated in pieces made of different tasks, with some of these pieces being able to be delegated to the robot and others not. This is the core of roboticists' imaginary of healthcare assemblages with robots.

Continuing with our analysis of the quotation about the robot for feeding, "*giving conversation*" is considered to be a valuable task for caregivers, a task associated with humans' affective needs. The time devoted to affective tasks is considered "*quality time*", and caring tasks performed in the meanwhile are considered "*quality care*". Conversely, "*spoon-feeding people*" is considered to be "*a simple thing*","*routine, repetitive jobs.*" These kinds of jobs could be assigned to a robot, and thus caregivers could devote themselves to "quality care". This way of understanding care tasks presupposes that there are some actions related to care that are more valuable than others. The most valued tasks are those that have to do with emotions and affectivity, and this most valuable part of care must be kept in the hands of humans. In this imaginary separation, daily performative tasks can be delegated to robots, detached from the more valuable affective and emotional tasks.

As it has also been identified by Arjanna van der Plas et al.[44], the roboticists' prospective vision of care associated with a future with robots is grounded in an idea of care as a set of activities that can be separated into two opposite poles: a tedious and heavy one, and an emotional and "real" one[45]. Care tasks are organized according to a dual system of exclusionary categories, namely: emotional or physical; valuable or non-valuable; delegable to a robot or exclusively human. This binary notion of care expressed by roboticists is the same as the one identified by Berenice Fisher and Joan Tronto thirty years ago[46]. This binary notion was based on the Western liberal tradition according to which a rational, autonomous person (a man, in traditional philosophy) accomplishes his life plan in the public realm. This tradition assumes a theory in which people are isolated and free in their activities and connections with others. In this tradition of thought, the ideal notion of caring associated with white middle-class women—what feminist historians have called the "cult of domesticity"—emphasized women's emotional and moral sensibilities versus the physical work of caring that could be done by servants[47]. The roboticists' differentiation of care into two hierarchical categories resembles that ideal developed in the 19th century around the "cult of domesticity", in which moral and emotional caring was considered valuable and should be done by humans, and the physical work of caring was seen as less valuable and could be done by robots.

With the translation of the imaginary of robots from industry into the daily life of care, care-giving tasks are conceived as manufacturing tasks, and therefore as divisible and separable. Those tasks which in manufacturing can be organized in an assembly line, in care settings can be distributed between caregivers and robots. This movement entails

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[44] Van der Plas, Smits, and Wehrmann.
[45] Ibid.
[46] Fisher and Tronto, "Toward a Feminist Theory of Caring".
[47] Ibid.

the need to classify every part of care according to this binary model of physical and affective tasks based on the cult of domesticity.

The roboticist who was in charge of the design of a robot to carry food from the kitchen to the dining room works in close collaboration with a residential home for people with severe intellectual disabilities. As he explained in the interview, one of the concerns of the care home management and care-giving workers was the problem of tending to all patients' needs during dining times, needs that could not be properly tended to with the existing personnel:

"*This is a task [that of bringing the food from the kitchen to the dining room] we want to automate to be released from a task that does not contribute anything… to move materials up and down when people could be taking care of patients. Right now, who brings the food carts from the kitchens to the dining room? Direct assistive staff. They go down… There are two of them, one stays alone, while the other one goes down to get the carts, and it is the assistive staff.*" Roboticist 7

From an ethics of care approach "organizing, marshing resources or personnel, and paying for the care work that will meet the identified needs" is considered part of the process of care[48]. However, the above quotation express how some daily tasks of the residential home, such as moving food, dishes or forks from the kitchen to the dinning room, are clearly separated from the idea of "*taking care of patients*". Although these tasks are necessary for the daily organization of caregiving to the people with intellectual disabilities that live in the residential home, they are considered as "*not contributing anything*".

The Robot in the Wildness of Daily Life and the Optimization Logic

As we explained, a robot is not a mere artefact, but a heterogeneous assemblage that encompasses a whole network of devices, processes and actors[49]. In the imaginary of care which is being mobilized, introducing robots can improve the care processes in which the robot intervenes, optimizing caregivers' work. If they are freed from the time they spend doing physical, dirty and repetitive tasks, they can devote more time and efforts to what it is assumed (which is a very big assumption!) to be the most valuable care, the emotional one. So, with this fragmentation, the notion of care assembled in care robots is deeply entangled with a caregivers' imaginary of work optimization.

With the development and introduction of HRC, researchers have discovered that collaborative robots can greatly improve productivity by saving money, simplifying programming and reducing the time it gets to obtain return from investments in areas such as product packing for shipment, production line loading and unloading, assembly operations, testing of parts, machine servicing, and logistics of workplace materials[50]. These values or characteristics associated with HRC also presuppose the historical reproduction of a set of biases associated with care, those represented by the cult of domesticity. Besides that, the translation of the imaginary of the robot from industry to the care domain also involves another movement that reinforces the fragmentation of care that we developed in the previous section.

In contrast with controlled manufacture environments, the everyday world is infinitively more complex and unpredictable, as we can see in the following quotation from Interview 9 explaining the challenges and difficulties that researchers and innovators have to deal with when developing robots and other artefacts to be introduced

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[48]Tronto, "An Ethic of Care." p. 17
[49]Latour, *La Esperanza de Pandora*.
[50]Bloss, "Industrial Robot".

in non-controlled environments to interact with humans. The quote clearly reflects the idea of the different logic of everyday life when compared with that of the industry:

"*If you were always the same, not a millimetre more to the right or left, the same, the same, the same, the same, like a car on a production line, which comes always in the same position, in the same way, always within tenths of a millimetre, if there was no variation, you wouldn't need AI. If there was no uncertainty, if everything was absolutely predictable and nothing deviated from the forecast… But in the real world things are not like that, things do not always come the same.*" Roboticist 9

While HRC makes it possible to imagine robots entering into the care domain, Artificial Intelligence (AI) enables robots to work in ordinary life. The fact that "*in the real world things are not like that*" requires the introduction of other technologies that, in their conceptualization, will be capable of understanding social relations in some way, social relations that "*do not always come the same.*" The notion of robots as a way to improve and to optimize productive processes has to be reconsidered in the case of care processes. As we can see in our interviews, when roboticists speak about robots for care, they give us a particular conception of daily life as life "in the wild", that is, an idea of daily life which is far away from the predictable and automated processes in the enclosed world of industrial robots.

The consideration of daily life as life in the wild is not neutral, it goes hand in hand with an imaginary in which predictability is a positive value; a positive value that robots, through the automation of care tasks, could introduce into daily life settings. Below, we present a paragraph from the interview with a roboticist who was developing a care robot for older people; in it, this idea of introducing robots as a way of reducing uncertainty both in everyday life and in care processes clearly shows up. Despite being a researcher with a long trajectory in the development of robots, the design of care robots was a relatively recent line of research for him. The main element explaining this change in his line of research was the aging process of his mother. As the roboticist was her main caregiver, during the interview numerous examples connected to their caring relation come up to illustrate the benefits of introducing robots into caring processes:

"*In medical cases, the worst thing you can find is to go to six specialists and have four of them give you one opinion and two, a different one. Therefore, in principle, systems that are automated give you always the same answer, whether it is correct or incorrect.*" Roboticist 7

In the following quotations, we reproduce two fragments which contain this idea of robots as positive useful actors in daily life that contribute to a reduction of uncertainty. The first one comes from an interview with a roboticist who was developing a robot to help children in their educational process with the aim of working from their own interests and talents. The second one is from an interview with a roboticist working currently on a robot for a paediatric hospital, but who uses care processes with older people as an example for explaining robots' utility.

"Question: *What is the added value of that [the introduction of robots in educational processes] being done by software, rather than by summer camps?*

Answer: *Suppression of biases and personalization. A father who's an architect is going to want his son to be an architect; one who's a mathematician is going to want his to be a mathematician, and nobody is probably going to detect in time that a child from Africa, for example, is good at electronics...*" Roboticist 5

"*There are cases in which human intervention may have been mistaken or may have been abusive. There are people who mistreat older people, for example. You are sure that the care robot will behave in a certain way, more human, less human, more*

automatic, less automatic, but it will always be the same and you have this certainty." Roboticist 2

Expressions such as *"systems that are automated give you always the same answer"* or *"you are sure that the care robot will behave in a certain way"* refer to a positive imaginary of control and predictability in the care relationships that could be introduced by care robots, as a way to suppress uncertainty and inefficiency in caring processes. That is, introducing robots into daily life means applying the logic of rationalization as a positive one, which in some way may definitely affect caring processes themselves when robots are used. Seeing care in daily life as uncertain and unpredictable, as defined by its opposition to rationalized processes, whatever their nature, means that the introduction of robots makes caring practices predictable, defined by a cause-effect relationship that optimizes care. Care robots are thus entangled with predictability as a positive imaginary of care.

AI opens up an infinite space for new imaginaries that undoubtedly go beyond the idea of delegating physical, heavy and repetitive care tasks to the robot. The dominant paradigm in AI revolves around the logic of the "rational agent", an agent that acts in order to achieve the best outcome, or the best expected one in case of uncertainty[51]. The idea of a rational agent is based on a specific comprehension of success in the tasks performed by means of AI, in a dimension that moves between two extremes: fidelity to how humans act, on one end; and what is considered the ideal of intelligence and rationality, on the other. Associating rationality with robotic AI, the dualism between the rational (which represents the ideal of intelligence) and the human (which moves in a wild and unpredictable range of relationships) is a constructed notion. Introducing robots into everyday life implies that the field of care is apprehended as "wild", in contrast to the rational and controlled environment of the factory or the laboratory. Such an imaginary places care at the opposite pole of the ideal of rational intelligence, reinforcing the dominance of productive criteria and cause-effect rationality.

As has been explained in the preceding paragraphs, the introduction of robots in daily life also implies transformations in the way we conceive everyday life itself. AI introduces into the robot the idea that care relations or care tasks are tasks "in the wild", which could be rationalised. As Dominique Cardon tells us, with AI and its algorithm-based language, everyday activities are organized by a calculation infrastructure[52]. "Just as the invention of the microscope has opened a new window on nature, digital sensors are spreading their net over the world to make it measurable in any case"[53]. This process, as interviewee 7 says, implies that the introduction of robots no longer affects only those activities considered physical or heavy, but the entire spectrum of caring relationships:

"Roboticist*: For a robot to manipulate soft or flexible things, or clothes, and to possess the intelligence to know how to fold them, and grab the tip… this is very difficult… Right now, it's impossible.*
Interviewer*: Is it more difficult than reading emotions?*
Roboticist: *Well, we can read emotions to some extent, through physiological signs, the heart rate, skin conductivity…"*Roboticist 7

The introduction of AI has opened a new window on the role of robots in daily life. With AI, care robots' functionalities are imagined different from industrial robots' tasks. We can read the words of Roboticist 6 in the light of these ideas when he explains the potentialities of developing care robots for nursing homes:

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[51]Russell and Norvig, *Artificial Intelligence: A Modern Approach.*
[52]Cardon, *À Quoi Rêvent Les Algorithmes.*
[53]Ibid.

"We can get behavioural profiles [...]. That right now nobody knows, there is not a sufficient sample that we know. So the robot, apart from keeping her company, is looking after her future, after her health. The robot is harnessing every day of its evolution.

[...]

"One of the purposes of robots is to fight solitude. The best thing for solitude is to have your family next to you, but..." Roboticist 6

With the introduction of AI in social robotics, care robots could be thought of as artefacts acting in the wildness of daily life, thus, developing functionalities connected to the "rationalisation" of the emotional or unpredictable social life, such as *"looking after"* people's future or *"fighting solitude."*

Fragmentation and Integration of Technological Care in Conflict

In our analysis of roboticists' imaginaries about care robots, we see how these imaginaries contain certain conceptions of care, which are organized around practices of care fragmentation. At the same time, from our approach to the radical imaginary we also want to introduce the creative capacity of imaginaries, which is always in dialogue with the social and historical conditions of the artefact. In pursuit of this objective, we confront the dominant imaginary of fragmented care entangled with the robot, with the core conceptual issues developed from the standpoint of an ethics of care which seeks to guarantee good life and common good. The ethics of care has been introduced into the healthcare domain both through general theoretical approaches[54] and through practical proposals[55], in controversies around the introduction of healthcare technologies[56].

Care fragmentation has been extensively contested from approaches in line with the ethics of care. In the academic literature, care fragmentation has been analysed from different perspectives: from that of the clinical field, from the area of care policies, or from research on STS regarding healthcare technologies. All these approaches are relevant for reflection on the ethical and social implications of the development of care robots. The approaches share a common logic about what fragmentation of care is, the same logic that is embedded in the development of care robots. Care fragmentation refers to the division of caring processes and relations into different sorts of care, which are then provided by people from different professions, by different organizational services, or by different devices.

From a clinical perspective, fragmentation is characterized by an increasing division of labour in healthcare, the standardization of roles and tasks, the rise of a managerial superstructure[57], and the degradation (or de-skilling) of physicians' and nursing work, in line with an emerging healthcare industry[58]. According to some analysts of healthcare fragmentation in the US, it leads to poor care coordination and so to higher costs and uneven quality[59]. Beyond the development of care robots, this process of fragmentation goes hand in hand with the diffusion of new technologies that shape everyday life in healthcare organizations[60]. In their analysis of telemedicine devices, Maggie Mort et al. explain how the technological artefacts that are employed shrink and

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[54]Tronto, "Human Rights, Democracy and Care".
[55]Metzler and Barnes, "Three Dialogues Concerning Robots".
[56]Finch et al., "Future Patients?".
[57]Agha, Frandsen, and Rebitzer, "Fragmented Division of Labor and Healthcare".
[58]Rastegar, "Health Care Becomes an Industry".
[59]Cebul, Rebitzer, and Taylor, "Organizational Fragmentation and Care Quality".
[60] Mort, May, and Williams, "Remote Doctors and Absent Patients".

parcel out identities in ways that objectify patients, and clinical skills are divided up in ways that lead to specific knowledge and practices becoming dominant, while others become devalued [61].

As we have showed, this pattern of care fragmentation is also embedded in the imaginaries of care robots. However, as innovation processes are not linear or homogenous, the fragmentation process and the prospective mediations that it entails are in tension with the approach supported by the ethics of care. This type of conflict or negotiation is the basis for a series of ethical controversies. We can see the controversy that shows up when Roboticist 9 alerts us to the potential risks of robots with AI and the need to ensure that humans will always be in the loop under this light:

"These people [potential patients cared by robots] must be clear that they [patients] cannot expect to receive real affectivity. They do not have any genuine interest in our state of mind. We should not be confused, it is not a person. It is true that there are people who do not have this emotion. But my experience is that the treatment of nurses, you see, they really have an interest, I am not telling you that everyone has one, but they quite often do. The aspect of medicine that has to do with human contact is very therapeutic."

[…]

"We must never remove humans from the loop… we must keep humans in the loop. We should always insist on an Artificial Intelligence with humans. It would not be desirable to speak of a hundred percent autonomy of these machines. So, a posteriori, in their day-to-day functioning, they should act as collaborators." Roboticist 9

This need to ensure the human stay "in the loop" suggests that there may also exist the possibility that humans were out of it. Would that really be possible? Or perhaps the problem is that the loop of human activities and relations might be fragmented and rationalised? The care fragmentation imaginary is not homogeneous, and it is in negotiation with another approach to care which values positively the non-uniformity of care relationships, claiming that "good care" is something that people shape, invent and adapt, time and again, in everyday practices[62]. This approach shows that good care does not have as much to do with the ideal of rational, productive and standardized protocols of individualization as with particular daily practices of care[63].

In the terms offered by Maria Puig de la Bellacasa, that would mean taking into consideration *matters of care*[64]. The notion of *matter of care* suggests that we should turn our attention to the analysis of how care operates in a sociotechnical context[65]. From this perspective, technological competency is understood as something which is integral to caring, and not as a separate thing[66]. The next quotation is about a paediatric hospital with a long history of introducing technological innovations and it refers to this issue:

"By technological innovation we mean when we make a new service, a new product or modify something we have in the hospital. For example, something very simple: we had some normal drip sticks and what has been done is a new drip stick dedicated to children. It is not a new instrument, but it is an absolutely differential

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[61]Ibid.

[62]Mol, *The Logic of Care.*

[63]See note 60 above

[64]Puig de la Bellacasa, "Matters of Care in Technoscience".

[65]*Ibid.*

[66]Latour, "When Things Strike Back".

element from what was before. For us, that's innovation. On the other extreme is the innovation of a new treatment for cancer that was not there before. If we apply this to robotics, since we are talking about these things, I would tell you that a few years ago robotics had never entered a hospital if it was not as a toy that a parent gave to a child to be in hospital. For the last four or five years, Lego has been part of the treatment with autistic children. Then we introduced a robot, which is Pleo, not only to see but to act, to lower anxiety." Roboticist 4

According to this idea, the introduction of matters of care in innovation processes has to deal with technological care-integration, necessary for robot introduction into healthcare settings. As it appears in the interviews, roboticists are also concerned with matters of care when introducing care robots in healthcare settings. The following quotations are all expressions of such concern:

"*The objective of any innovation in the protocols, treatments, systems of intervention or diagnosis, etc., be it at the technological level or at the level of procedures, is the improvement of the child's quality of life".* Roboticist 4

"*Care and health also have to do with hygiene, and they also have to do with the psychological part of a person, and they also have to do with your well-being and they also have to do... they have many dimensions.*" Roboticist 2

Thus, roboticists' imaginaries are quite complex and traversed by different tensions produced by the coexistence of such imaginaries of fragmentation with an integrated conception of care. Care is no longer emotional, privatized, and made up of feminine activities, but it consists of the network of activities, organizations, relations that sustain us and the world we live in[67]. The roboticists' concerns when introducing care robots in healthcare settings also have to do with an integrated idea of care; care as configured by *"many dimensions"* aiming at "*the improvement of the quality of life".* Reducing care to physical or emotional activities, as well as opposing human care to rational care, has relevant political and ethical implications. Care goes beyond tasks or hands-on work, and beyond isolated entities that take care or receive care[68], which is the conceptualization of care that is embedded in fragmented care robots' imaginaries. Care has many dimensions and is always performed in a complex network of social, semiotic and material relations, which also involves political decisions or institutional commitments, and has certain economic implications[69]. And, as we have shown, all these considerations are part of the ethical debate on care robots.

Conclusions

Based on eleven interviews with roboticists, we studied care robots' imaginaries as a tool for widening the ethical debate surrounding the introduction of robots in healthcare. We understand imaginaries in a way that is closer to Castoriadis's notion of the radical imaginary. From our willingness to confront a dominant imaginary in robotics, we propose an ethical debate around what the good life in common means and what makes us feel good, both as individuals and collectively, a debate mediated by the ethics of care. We maintain that the imaginaries of care robots are configured in the process of translating the imaginary of robots from the industrial field into the wildness of the daily life of healthcare. This process is accompanied by a set of movements based on a collective process of care fragmentation that reconfigures the comprehension of robots

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[67]See note 46 above.
[68]Arneil, "Becoming Versus Being".
[69]Sevenhuijsen, "The Place of Care".

and their mediations. This fragmentation is intensively entangled with HRC and AI imaginaries of care, which are based on the cult of domesticity that separates care into physical and tedious activities and emotional ones, and on the fragmentation between human caring and rational caring, grounded in the opposition of humans to robots.

In our analysis, we note how the imaginaries that all these fragmentations entail are in tension with the approach proposed from the ethics of care, which seeks to re-conceptualize care in a broader fashion, more comprehensive and integrated. After establishing a dialogue between fragmentation and matters of care, we are able to identify a set of issues that could be summarised in two main ethical controversies: a controversy about the ontology of care (dualist/integrated), and a one about the operating logic of care (productivity logic/care logic).

From these results, we stress the need to explore alternative caring imaginaries for care robots that accompany the reflection on the ethical, political and social implications of introducing robots in the healthcare domain, to position care robots' mediations as social and moral practices in an assemblage of relations that sustain ourselves and the world we live in. Fragmentation *per se* is not negative; however, when fragmentation is sustained by an ideology (the cult of domesticity) rooted in a system of values that used to remove women from the public sphere, with their consideration as human beings inferior to that of men, such fragmentation should be placed under suspicion. Similarly, when the ideal of intelligence starts from a dual model in which, on one end, there is a rational cause-effect model and, on the other, the unpredictable world of human daily life, the ideology of the power of efficiency, predictability and productivity colonizes the sphere of care, and this dualism should be questioned.

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