A critical analysis of the representations of older adults in the field of human–robot interaction

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Abstract

This paper argues that there is a need to critically assess bias in the representations of older adults in the field of Human–Robot Interaction. This need stems from the recognition that technology development is a socially constructed process that has the potential to reinforce problematic understandings of older adults. Based on a qualitative content analysis of 96 academic publications, this paper indicates that older adults are represented as; frail by default, independent by effort; silent and technologically illiterate; burdensome; and problematic for society. Within these documents, few counternarratives are present that do not take such essentialist representations. In these texts, the goal of social robots in elder care is to “enable” older adults to “better” themselves. The older body is seen as “fixable” with social robots, reinforcing an ageist and neoliberal narrative: older adults are reduced to potential care receivers in ways that shift care responsibilities away from the welfare state onto the individual.

Keywords Older adults · Human–robot interaction · User representations · Ageism · Neoliberalism · Elder care

1 Introduction

Since the early 2000s, social robots in elder care are developed and studied in academia (e.g., Wada et al. 2003). Often, the field is seen as socially good due to the anticipated crisis resulting from aging populations (Neven and Peine 2017). The field of human–robot interaction (hereafter HRI) in elder care would benefit from a critical analysis of how it perceives its prospective primary users, i.e., older adults. As most scholars in HRI do not have the lived experience of being a (care dependent) older adult, they have to rely on additional information (Hyysalo and Johnson 2016). This dependency on external representations could potentially reflect and reproduce problematic understandings of older adults. Therefore, a critical analysis of the representations of older adults in the field of HRI is necessary to become aware of potential biases and assumptions that might further inform the construction of technologies. Related to this is the theoretical argument of social constructivism and the

rejection of technological determinism. This present study builds on the idea that there is no inherent, natural, or inevitable logic to the development of technologies, as it is subject to social processes (Bijker 2010). Designing for older adults therefore does not follow a particular inevitable logic. Furthermore, compared with other social groups, scientists and engineers have a form of expertise that makes them relevant actors in the social construction of technologies (Bijker 2010). Given (1) the relative importance of scientists and engineers in the field of HRI in elder care and (2) the not-so straightforward task of studying and designing new technologies for older adults, it is relevant and necessary to study bias and assumptions about the anticipated user group, i.e., older adults, in the academic field of HRI. Bearing this in mind, the guiding research question reads: how are older adults represented in the field of HRI in elder care? This question is answered with a qualitative content analysis of academic publications ($n=96$) that design or study a robot or robotic system. Before explaining the methods, a theoretical overview follows that discusses the concepts; robots; user representations; older adults; older users.

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1.1 Theoretical framework

1.1.1 Robots

In this paper, robots are conceptualized as embodied systems in which a connection is made between perception and action (Siciliano and Khatib 2008). While many different kinds of robots exist, generally speaking, robots have a body that is able to move (e.g., wheels, propellers, robotic hands or arms) with the help of sensory input and actuators. For elder care specifically, there are different types of robots available, accompanied with different terminology. To illustrate the lack of cohesive jargon in the field, the following concepts were encountered during a literature search: socially assistive robots (e.g., Tapus and Mataric 2008; Khaksar et al. 2015), mental commit robots (e.g., Wada et al. 2003), social robots (e.g., Bartl et al. 2016), and care robots (Jenkins and Draper 2015), etc. Though a cohesive conceptualization is yet to be formulated, one can observe a rough distinction between play based/motivational robots that are supposed to enhance cognitive function and/or social interaction (e.g., Wada et al. 2003), and robots that are specifically used for pragmatic care related purposes (e.g., Zlatintsi et al. 2017). This observation is also aligned with health policy literature on elder care, in which caregiving is considered both a social and a pragmatic activity (Pavolini and Ranci 2013). Having conceptually clarified robots in elder care, the following paragraphs discuss how user representations matter in the social construction of technologies.

1.1.2 User representations

Of particular interest in this paper are publications in Science and Technology Studies (hereafter STS) that focus on user representations. As an academic field, STS looks at how “the social” and “the technical” are interrelated, or rather: enmeshed. In this paper, a social constructivist perspective is applied to understand how bias and normativity is embedded in the ideas put forward by scholars working on HRI in elder care. In STS, a social constructivist perspective on technology, is found in Social Construction of Technology, SCOT hereafter (Pinch and Bijker 1984). This theory explains how social processes shape the construction of technologies. SCOT started out as a theory that aims to explain how technologies are made. It emphasized the malleability of artifacts and thereby dismissed the idea of technology construction as an inevitable, linear, or technologically deterministic process. Since its development in the 1980s, SCOT has incorporated various other conceptual ideas that acknowledge a less human-centered viewpoint on the construction of technologies by for instance using the concept “sociotechnical ensemble” (Bijker 2010: 66). Nonetheless,

this paper will stick to the core principles of SCOT: the malleability of artifacts, the rejection of technological determinism, and the research agenda that asks how technologies are made instead of what technologies conceptually “are”. Other scholars in STS have also studied how technologies are made in relation to user representations albeit from a different theoretical angle than SCOT. Woolgar (1990) for instance, uses the analogy of machine-as-text to describe the active configuration of users by designers. Configuring the user concerns the active establishment of relational boundaries between users and product based on user representations. Certain uses are encouraged, while others are discouraged in the design, much like writers communicate their stories with certain intentions and expectations. In a similar fashion, Akrich (1992) describes how the process of inscription relates to embedding certain worldviews into artifacts. The technical composition is in essence the realization, or rather materialization, of ideas about, e.g., users. This present paper aims to understand the content of these ideas in relation to older adults as a potential user group. Scripts as a concept, therefore, enables researchers to study sociotechnical intentions and worldviews of designers.¹

1.1.3 Older adults

A couple of interrelated key concepts ought to be clarified: older adults and older users. In this study, both are seen as social categories, but older users are treated as a specific sub-category of older adults. Specifically, older users are older adults who interact with, in this case, social robots. This study would like to capture both user and non-user related assumptions. In the analysis, this may lead to different types of representations, referring to both older adults as a general social category, and older adults as older users. It is therefore necessary to understand literature on both social categories, as is presented in the following paragraphs. Much has been written in literature on the conceptualization of aging and older adults. In his understanding of the life course, Laslett (1991) refers to four different categories: first age, second age, third age and fourth age. Age categories refer to functionality, experience, maturity, and (in)dependence, rather than the mere passing of time as is illustrated in his definition of the four divisions of the life course: “First comes an era of dependence, socialization, immaturity and education; second an era of independence, maturity and responsibility, of earning and of saving; third an era of personal fulfilment;

¹ Even though scripts acknowledge that, depending on the script, artifacts invite or inhibit certain reactions from its users, the twin-concept description simultaneously describes how usage is not determined by technological artifacts. This latter concept is not discussed in this paper.

and fourth an era of final dependence, decrepitude and death” (Laslett 1991: 4). So rather than referring to older age as a specific cut in one’s chronological existence, the life course is divided into four spheres of general functioning. In other words, older age does not start at 65 years, 55 years, or 70 years, but instead refers to, e.g., (in)dependence typically associated with the third age and the fourth age. Similar to Laslett’s (1991) classification of the life course, other concepts and theories such as disengagement theory, successful aging, and activity theory refer to (in)dependence and general functioning at an older age, albeit with a normative stance. While disengagement theory describes aging as a process of inevitable loss and of natural withdrawal from society, the concepts of successful aging and activity theory stress the malleability of aging (Katz 2000; Bülow and Söderqvist 2014). According to the latter approaches, older adults are able to actively choose to better their lives by making healthier lifestyle choices, and thereby contribute to their own longevity. Studies in gerontology focus not only in treatment of age related diseases, but also on the prevention of age related diseases. Aging is seen as a process of activity and self-realization instead of a process of decline.

These concepts of activity theory and successful aging are contested. After all, what is “successful” aging and who are the “unsuccessful” older adults? This concept implies that older adults could be classified in terms of winners and losers, thereby establishing a normative hierarchy of an inevitable biological process. Furthermore, scholars who published in the field of critical gerontology, Katz (2000) and Mikkelsen (2017), criticize not only this narrative of accomplishment but also the implicit premise of productivity and enablement that the concepts of successful aging and activity theory carry with them. According to these scholars, these concepts embed a neoliberal perspective on aging. With active aging and successful aging, the functioning of the individual is reduced to his/her individual responsibilities and lifestyle choices. “Facts” produced by social gerontologists or other experts on how to age “responsibly” help the individual to make “better” choices. Older citizens are thereby called upon their responsibility and accountability instead of shifting this to the welfare state (Katz 2000). As Mikkelsen (2017: 647) puts it, ideas of self-realization are “closely tied to wider political strategies for minimizing the budgetary strain on public health systems and managing the aging population in the face of the contemporary increase in life expectancy in Western countries”. This perspective on aging, i.e., self-governing the older body as an act that serves the interest of the state and its ideologies, does not necessarily describe *how* older adults *ought* to age, which activity theory and successful aging does. Rather, it describes how power is intertwined with knowledge, discourse, and governance. Specifically, both Katz (2000) and Mikkelsen (2017) argue how narratives about active aging

backed up by social gerontologists are considered as “truisms”, but simultaneously serve as disciplinary strategies for neoliberal political agendas that aim at restraining public spending on elder care. In sum, while the field of social gerontology has defined older age in terms of functionality and malleability, critical gerontologists Katz (2000) and Mikkelsen (2017) view this perspective in terms of a neoliberal ideology. The question is then how this aligns with the field of HRI. This paper, therefore, discusses what narratives of older adults are put forward in the field of HRI concerning functionality and malleability, and what that means in terms of a neoliberal ideology.

1.1.4 Older users of new technologies

Typically, when discussing older adults and their use of new technologies, the academic literature refers to concepts such as the “digital divide”, “have-nots”, or “non-acceptance” (e.g., Abbey and Hyde 2009; Friemel 2016; Lüders and Bae Brandtzæg 2017). When studying older adults in relation to such concepts of non-users, the premise is often based on an interventionist logic in which the introduction of a new artifact would lead to some kind of (positive) effect (Peine and Neven 2019). However, as Peine and Neven (2019) mention, this perspective might be a bit simplistic. An interventionist perspective assumes particular characteristics of older adults that ought to be changed, and then translates these assumptions into design. In doing so, this process *constructs* normativity (Peine and Neven 2019). It reproduces a normative hierarchy of how older adults ought (not) to age. This suggests that (1) the sampled representations could refer to an interventionist logic and (2) it ought to be critically understood how this interventionist logic contributes to ageist representations of older users. This paper, therefore, discusses the findings in relation to users, non-users, and ageism, in addition to neoliberalism and the malleability of aging.

2 Methods

A qualitative content analysis was conducted on academic publications ($n = 96$). A list of all sampled publications is provided in Online Resource 1. These publications are not restricted to particular fields. Instead, the sample includes publications from various disciplines in academia, going beyond solely engineering and computer science disciplines. Additionally, some authors of these publications are affiliated with organizations outside of academia.

This resulted in a very heterogeneous sample. The sampling strategy followed the logic of trying to capture the field of HRI in academia in its broadest sense, in order to not favor one discipline or academic/industrial background over the other. This highlights a broad potential audience reach,

with potential effects in the development and construction of social robots that are not restricted to a particular university background or an institute. However, regardless of the disciplinary or organizational background of the authors, one pre-requisite was that the publications were published in an academic outlet reflecting a standard of academic rigor (in for instance a peer-reviewed journal, conference proceedings, anthology, etc.). However, there was no assessment conducted on the quality or ethics of the sampled publications, nor were the publications omitted that had specific funds. This approach to capture the academic field of HRI in elder care in its broadest sense allowed for this paper to examine the field “as is” with limited preconceptions. Academic publications were chosen as a sampling site because it is regarded as a site of knowledge production (i.e., a certain level of expertise is practiced there) and is primarily where scholars of HRI in elder care make a deliberate argument about their work, e.g., what technological artifact they are developing/studying, for whom and why.

The databases DBLP, Web of Science, and Scopus were chosen to retrieve these publications. These databases were selected given that they include literature in engineering and social gerontology and because they nest other databases such as IEEE and ACM in their digital libraries. After the selection of these databases, search terms were defined. The publications needed to incorporate two elements, specifically, social robots and older adults. Therefore, terms were selected which referred to both concepts: *Social robot* in combination with age related elements (“aged”, “aging”, “elder*”, “senior*”, “old*”, “dementia”, “*care*”, “Alzheimer”, “ageing”). The asterisk refers to search words that could be prolonged, such as “eldercare” or “elders” when looking up “elder*”.² While there are different ways to refer to social robots as mentioned earlier, social robots was chosen specifically because the terminology includes a broader range of robots than for instance specifically “healthcare” or “tele-operated” robots. Additionally in terms of feasibility, this work was conducted by the author in the context of a PhD dissertation. This limited time for a further sampling of databases and terminology. The sampling procedure ended when all results of the three databases were checked.

There were a couple of exclusion criteria used in the sampling process. First, papers were excluded if studies did not relate to the main theme of this research: elder care and social robots. For instance, the search terms “*care*” in combination with *social robot* also retrieved papers related to pediatric care. Furthermore, duplicates were removed. Papers were also excluded if they did not design an artifact or empirically analyzed one (i.e., publications that did not

refer to specific technologies were not selected). Theoretical papers (mostly reviews) were in this way omitted. Finally, the sample needs to be manageable, it only took publications into consideration that had the search words reflected in the title.³ This filtered out all the publications that would have the search terms listed elsewhere in the paper (e.g., in the main body of text or in the abstract). This resulted in a narrower search than originally desired but one that was manageable and focused nonetheless. The PRISMA flowchart in Online Resource 2 details the publication numbers captured in the sample and those included or excluded with each step.

The sampling procedure was conducted in June 2018. The time interval of the years of publication ranges from 2003 to 2018. The study does not conduct an analysis on how the representations may or may not have changed over time as the aim of this paper was not to observe temporal difference. The social category here can be seen as fairly robust: older age. It is not expected that ideas about aging would shift paradigms drastically in this amount of time.

To analyze representations of older adults, all publications were read with the intention of sampling quotations about older people.⁴ This does not concern the description of “actual” people, but rather generalizations of what it means to be older. These generalizations about older adult’s functioning (e.g., activity/inactivity, independence/dependence, etc.) guided the thematic analysis together with the sensitizing concepts third age and fourth age. Its salience found in the social gerontological literature made the researcher anticipate its relevance in the literature on HRI in elder care.

All sampled publications were read with the sensitizing concepts in mind, resulting in a process of open coding: quotations deemed relevant for this study were marked and these quotations were given codes. These codes were compared and contrasted with each other in order to understand commonalities in the representations of older adults. This process of data reduction was repeated until a couple of main themes remained. The final step was to understand how the main themes relate to each other, again a process of comparing and contrasting. To illustrate how this worked, quotations such as the following were sampled: “Older adults are *vulnerable* to the experience of *loss*, be it in terms of health,

² DBLP is not sensitive to these symbols, making the sample slightly larger than initially hoped for.

³ In the case of DBLP, the search words were reflected in the title and the journal name. The journal name was not initially part of the search strategy, but DBLP at that time did not allow this option to be filtered out, resulting in a larger pool of publications coming from DBLP compared with Web of Science and Scopus. However, DBLP has updated their search strategy since then as is explained in Online Resource 2.

⁴ Prior to this study, all publications were already analyzed with grounded theory as part of another PhD paper. So the researcher was already familiar with the content of these publications, but nonetheless proceeded to re-read and analyze the publications once more, this time with a different conceptual focus.

identity, finances, independence and social connections” (Khosla et al. 2013: 42). The words “vulnerable” and “loss” are emphasized because one of the sensitizing concepts—fourth age—relates to these words. Whenever another piece of text would refer to the same mechanism, it would be sampled and coded accordingly. For instance: “*Generally speaking, elderly people are depressed easily, as they have hard experiences such as lost their family, friends, social roles, and physical functions*” (Wada et al. 2005: 2785).⁵ This also refers to the process of loss and vulnerability. After coding all texts, a pattern emerged that showed similar narratives, ultimately resulting in the theme “frailty”. Once all themes were established, they were compared and contrasted with each other. For instance, alongside “frailty”, representations of “independence” were found. The researcher then analyzed how these themes related to each other: are they opposite themes or is there an overlap found? In other words, in the final steps of the data analysis the relational aspect of the main themes were studied. The results discuss each theme with quotations to illustrate how the data supports the theme. Though this is a thematic analysis and not a discourse analysis, sometimes particular words are emphasized because they carry a lot of meaning (e.g., “abnormal”). Finally, before discussing the results, it should be noted that not the publications are coded as such but rather snippets of texts. One publication could include different representations of older age. Rather than stating how publication X represents old people as Y, this present research analyzed different representational themes that are interwoven throughout the field and sometimes in the same text. Also, though each theme has a large body of quotations to support its content and therefore could have been used interchangeably in the presentation of the results, the quotations chosen for presenting the results reflect the key concerns of the argument in a well-articulated or concise manner.

3 Results

Different themes were derived from the analysis: older adults and their general functioning, older adults as users of new technologies, older adults and others, older adults and society. As is discussed in the following paragraphs, these themes represent older adults in terms of essentialist narratives of the third/fourth age, while very few cases offer a counternarrative.

3.1 Older adults and their general functioning

Older adults are represented in the HRI literature in terms of a couple of distinctive traits. Their functioning is reduced to narratives of (in)dependence and (loss of) capabilities. Older adults are seen as people who experience loss in social participation, health and mobility, and cognitive and mental functioning—i.e., fourth agers. For example, Sakamoto et al. (2016: 60) mention that “ageing is *inherently a difficult time in an individual’s life*; as the leading risk factor for most human diseases, *the elderly is often besieged on multiple fronts* by physical, psychological and cognitive frailty”. Similarly, Sung et al. (2015: 1) describe loss as an inherent part of older adults experiences, much like a domino effect: “As older adults age, they may face and *experience difficult situations and losses*, such as loss in their health and functions, family, friends, and social roles. These situations *may force older adults to become depressed and suffer from mental health problems*, such as depression and social isolation. Depression is prevalent among older adults and *could lead to severe health problems with detrimental impact on their functional status, quality of life, and a poor prognosis* (Licht-Strunk et al. 2007)⁶”. Social robots are supposed to alleviate or fix these traits of frailty, dependence, and vulnerability. These robots are regarded as being able to activate older adults by, for instance, compensating for social loss by acting as a social companion or by training cognitive functions with games. Activity is viewed as key to countering these losses, and robots are thought of as enablers of activity and overall wellbeing. For instance, one study explicitly mentions how “older adults are *vulnerable* to the experience of *loss*, be it in terms of health, identity, finances, independence and social connections” (Khosla et al. 2013: 42) and that their named robot Matilda⁷ ought to “(...) *improve emotional well being by enabling elderly to be productive and useful*, helping them become *more resilient and cope better* through personalization of services provided by Matilda. This in turn *enhance their quality of life*” (Khosla et al. 2013: 41). Another example of how a robot is supposed to “fix” the frailty of older adults is presented in the publication of Given-Wilson et al. (2017: 90) with their social robot walker FriWalk: “People with impaired physical and mental ability often find it challenging to negotiate crowded or unfamiliar environments, leading to a *vicious cycle of deteriorating mobility*. This also severely impacts sociability, and

⁵ All sampled quotations are literal quotations, i.e., no grammar or spelling check was conducted on the data.

⁶ In this paper, all references that appear in the quotations are not listed in the bibliography, since they are not actively used in the argument here but rather reflect the *literal* quotation from the data. Furthermore, all in-text emphases are inserted by the author of this present paper.

⁷ The robot is PaPeRo, but was renamed for their study.

increases isolation, that in turn provides *an additional cycle of deteriorating health and well-being*. To address these issues the ACANTO project is developing a robotic assistant (called a FriWalk) that supports its users by *encouraging and supporting them to engage in therapeutic group social activities*". Not all representations explicitly refer to older adults as frail or vulnerable. Sometimes, the narrative was more subtle by referring to issues as maintaining independence, maintaining personhood, self-enhancement, or prevention of aging related processes. Indeed, some publications regard older people as to already have certain active qualities, i.e., third agers, which need to be maintained with the help of social robots. This, however, simultaneously implies that aging ultimately leads to an undesirable future of dependency, frailty, vulnerability etc. For instance, Portugal et al. (2015: 812) mention how their robotic platform is merely an *"intermediate agent between the elderly and the social care community"*. The authors developed an interpersonal communication platform that relies on the social network of the older user. The robot is not meant to create companionship, but to enable interaction with the pre-existing social network of the older user. Also, the authors describe how they *"consider the elders as active collaborative agents able to make personal choices and the care model is adapted to their lifestyle, personalized needs and capabilities changes over the aging process"* (Portugal et al. 2015: 812). While this is a very different representation of older age than discussed earlier in terms of capabilities and functioning, the premise of the aforementioned publication follows an interventionist logic that ought to prevent older adults from becoming frail and needy. For example, consider the following excerpt: *"Several demographic studies report that Europe's population is aging, as the average life expectancy over the years increase [1]. As a consequence, the elderly care market is growing, revealing a huge unexplored potential. In order to address these challenges, there is growing attention for assistive technologies to support seniors to stay independent and active for as long as possible in their preferred home environment. Robotic systems are among those initiatives offering functionality related to the support of independent living, monitoring and maintaining safety or enhancement of health and psychological well-being of elders by providing companionship. The SocialRobot Project¹ aims to provide an answer to this demographic change challenge. Therefore, an integrated Social Robotics system is under development to address key issues for improved independent living and quality of life of the elderly people"* (Portugal et al. 2015: 811). While this fragment is not too clear about what is meant with *"the demographic change challenge"*, it clearly shows an interventionist logic. Older adults need technological intervention to *"better"* their lives, stay independent as long as possible, and counter whichever undesirable (and undefined) effect of aging demographics with

social robots. While at first the publication of Portugal et al. (2015) seems to touch upon concepts of active aging and the third age, it still adheres to the logic of an inevitable fourth age that ought to be prevented. Therefore, the representation of self-enhancement, improvement, and independence goes hand-in-hand with narratives of frailty and dependence. One does not exclude the other. In short, two interrelated representations about the general functioning of older adults are found: frailty and dependence; self-enhancement and independence. However, this interrelatedness does not imply neutrality or a balanced representation of older age. Independence and self-enhancement reflects the assumption that without technological intervention, older adults eventually become fourth agers. Generally speaking, older adults are represented as either frail people or people that have the potential to become frail. In other words, older adults are represented as frail by default, and independent by effort.

3.2 Older adults as users of new technologies

One particular strand in the representations of older age focuses on older adults as (prospective) users of new technologies. Two, often interrelated, themes are found: silenced prospective users and technologically illiterate people. The former refers to representations mostly found in user acceptance studies, which is research on how to maximize the acceptance of robots. This strand in HRI literature does not question the need for such robots, nor does it ask whether older people want to become older users of social robots *überhaupt*. The goal is to maximize acceptance regardless, thereby silencing the voices of older people regarding technology-use. For instance: *"Social interaction and interactive communication are recognized as helpful strategies to maintain the abilities of people with dementia (PwD) and improve their quality of life [2]. Elderly people need to accept social robots into their home environments to profit from favorable outcomes of social robot use. However, before we can determine if an interaction with a social robot benefits the PwD, it is necessary to understand the process of acceptance of the robot by the PwD. (...) The primary aim of the study was to identify which strategies could have a positive effect on the interaction between PwD and robot improving the acceptance"* (Cruz-Sandoval et al. 2018: 95). By studying how to maximize technology acceptance, the authors do not question the basic premise of using social robots in elder care, its effects, or if older adults want to use robots at all. To give another example: *"If robotic companions are to be used in the near future by aging adults, they have to be accepted by them."* (Heerink et al. 2008: 33). The authors continue their argument for the need for acceptance based on the assumption that the use of social robots in elder care is both inevitable and inherently good for the older user and for society at large due to

aging demographics. However, the authors state that older adults might be reluctant to accept such technologies: “Thus, robotic companions are generally considered a potentially major part of the technology that can address the problems of a growing older population and increasing labor shortage in the industrialized world. However, there are *challenges to be met—and not only technical ones. Elders do not always willingly accept new technologies and it might be crucial to map the psychological requirements that designers of robotic companions have to take into account* [4]” (Heerink et al. 2008: 33). This latter statement connects to the second theme found in the representations of (prospective) older users: the digital divide. A lot of the problems of acceptance are allocated to the users. They are seen as digitally illiterate people who do not understand how to operate new technologies. Therefore, most robots are suggested to require a more intuitive form of interaction that fits the older user (e.g., Looije et al. 2010; Pino et al. 2012). But sometimes, that resulted in very bold statements, such as the following. “More understanding is required of factors *that minimise the rejection of eldercare robots and optimize their acceptance*. There is some understanding of robot factors that promote acceptance; notably that the robot is both useful and easy to use. There is also some knowledge of human predictors of acceptance. However, known human predictors of technology acceptance tend to be fixed and/or historical demographics. For example, *female gender and older age have been associated with low acceptance of novel technologies* [11].⁸ There are two issues with fixed demographic factors as acceptance predictors. One issue is fixed factors may predict non-acceptance of technology, but do not explain the underlying causes of non-acceptance. The second issue is that, by definition, fixed predictors are fixed. *It is not possible to make older women more accepting of novel technologies by changing their gender and reducing their age*. However, unlike demographics, psychological characteristics of potential technology users may be less fixed. Greater knowledge of potentially modifiable psychological factors associated with the acceptance and rejection of robots in an aged-care context *may assist designers in creating acceptable eldercare robots to help meet the challenges of ageing populations*.” (Stafford et al. 2014: 17–18). This statement implies a normative hierarchy of women and older adults naturally being less capable, for whatever reasons, to adopt new technologies than younger men. While other publications did not focus much on gendered differences, older age was repeatedly seen as a factor for being less capable of

interacting with new technologies. To give another example: “PROMs is based on the need for providing evidence of performing value-based health care. Up till recently PROM data were mainly collected with paper-and-pencil methods, and since a few years e-health solutions such as apps on tablets or smartphones are used, where answer options can be selected by touch buttons. However, *elderly people often do not have the e-health literacy for using these devices* [6], or find the technology difficult to use due to their disabilities and chronic diseases. A social robot which can conduct a verbal dialogue, supported by gestures and an answer display, *would not require e-health literacy from the patient*” (Boumans et al. 2018: 73). In short, in the literature, two representational themes discuss older adults in relation to technology-use. In the first theme, older users have to accept robots due to the “undeniable” foreseen benefits, while the voices of older adults themselves are silenced. In the second theme, older users are represented as technologically illiterate, hinting at a characteristic associated with the fourth age.

3.3 Older adults and others

In relation to others, older adults are seen as a burden. This is especially relevant when it comes to caregiving, as this is considered to be a stressful activity. One publication claims that older adults are burdensome for others financially. “Currently, more than *18.1 billion hours of unpaid care are provided by the family and friends of older adults suffering from dementia which results in a loss of \$15, 000 in the annual income of such caregivers* [1].” (Fernandes et al. 2007, Introduction, para 1).⁹ The introduction of social robots would ultimately “*decrease the financial burden in our health care system*.” (Fernandes et al. 2007, introduction, para. 1). This burden is not only limited to informal caregiving, but also relates to formal settings: “Medical staff uses Patient Reported Outcome Measurement (PROM) questionnaires as a means of collecting information on the effectiveness of care delivered to patients as perceived by the patients themselves. *Especially for the older patient group*, the PROM questioning poses an *undesirable workload* on the staff.” (Boumans et al. 2018: 73). Typically, older adults who are described as burdensome in the literature are people with dementia or Alzheimer’s disease (e.g., Salichs et al. 2016) or with mental health issues (e.g., Sung et al. 2015); however, these descriptions are not limited to those groups (e.g., Reppou et al. 2016). Robots are supposed to alleviate these “burdensome” aspects of aging by increasing independence and activity of their older users. Similar to the other representations, this theme refers to the fourth age, as the burden is defined by dependency and vulnerability of older adults.

⁸ In-text quotation reference: Venkatesh et al. (2003) as cited in Stafford et al. (2014). When fact-checking this statement by looking up the in-text reference, it turns out that gender and age have different motivations for (not) using technologies, which is not synonymous for lower levels of acceptance.

⁹ No page numbers are listed in this publication.

3.4 Older adults in society

As a collective, older adults are represented as a potential problem due to the anticipated change in demographics. The relative number of older adults compared with other age cohorts is expected to increase over the years, leading to a number of foreseen problematic societal effects. More specifically, the number of care-dependent people is anticipated to increase, which in turn would lead to an increase in care expenses. Second, the rise of care-dependent people would change caregiving. It would put pressure on the job quality of (in)formal caregivers and also lead to a shortage of caregivers. Third, and related to the other arguments, there would be a relative increase in the number of ill, care-dependent people with a lower quality of life. Together, these arguments illustrate economic representations of aging. Robots are seen as a solution to decrease costs, make older users more independent from caregivers and hence compensate for the shortage of caregivers/alleviate the care burden from caregivers, and making older adults healthier and happier. To illustrate each of these representations chronologically in terms of finances, care provision, and health and wellbeing: “With the increase in the population of the aged people in the United States and all other countries in the world, there is a crucial need for a *better* personalized health care system. Socially Assistive Robotics (SAR), as a part of assistive technologies, aim at providing healthcare for people and particularly for the aging population and *decreasing the current healthcare services costs*. The estimated fivefold increase in the population of people over the age of 85 by the end of 2050 [28] points out the *importance of such technologies*. The ultimate goal is to treat *abnormal social behaviors* caused by stroke, childhood diseases, or depression as well as improving social skills in general.” (Kargar and Mahoor 2017: 756). “The demographic change causes an *imbalance between the number of elderly in need of support and the number of caring staff*. Therefore, it is important to help older adults *keep their independence*. (...) According to the United Nations Department of Economic and Social Affairs [1] 21 percent of the world’s population will be older than 60 years in 2015. This causes an *obsolescence of society and consequently personnel bottlenecks in elderly care*. At this point robotic systems can help *foster older adults’ autonomy* (Bartl et al. 2016: 681). “Census data show that in most countries, and particularly in Europe, there is an increase in both the number of elderly people and in the percentage of elderly people among the overall population, leading to a *proportional increase in the number of people affected by mild cognitive impairments* [1], [2]. As the importance of training cognitive abilities *to slow down the progress of dementia* is now an established fact [3], research has focused on the *development of automated systems for the assistance of elderly people in the execution of everyday activities* which require planning

capabilities” (Bruno et al. 2013, introduction, para. 1).¹⁰ To briefly summarize, the anticipated demographic shift is seen as problematic. Due to this theme’s focus on older adults as a care-dependent demographic cohort that will negatively impact the economy, one could refer to older adults as “the collective fourth age”. Robots are regarded as a solution to make older users more active and independent, thereby compensating for all of the foreseen problematic effects of aging populations.

3.5 A counternarrative

So far, the results indicate that older adults are portrayed as (potential) fourth agers. Very few counternarratives were provided that did not describe older adults in essentialist terms. To be specific, only two cases were found in which the authors mention to try to describe complexity “as is”, instead of reducing older adult’s qualities, traits, and experiences to their (in)abilities. Both of these cases were rooted in STS, postphenomenology and anthropology. In their ethnographic studies, Neven and Leeson (2015: 99–100) explain that they do not want to describe the experiences of older adults in essentialist terms: “It is important to realize that there is a great diversity of social robots and this diversity of designs of robots is more than matched by the diversity of older people. *This makes it impossible for ‘robots’ to have one clear and unequivocal effect on ‘older people’ as both categories are grossly oversimplified in such reasoning*”. Similarly, Pfadenhauer and Dukat (2015: 397), did not engage in discussing general traits of older adults, or how they behave as potential users. Rather, they mention the importance of maintaining complexity instead of reducing it: “In what follows, *we shall not be commenting on the potential therapeutic effectiveness of PARO*, which numerous studies have endeavored to prove by means of physiological and psychological testing. (...) Rather, we endeavor to understand the social order into which humans are integrated and which is, at the same time, a product of human activity. In so doing, we do not look at society through a wide-angle lens. *Instead, we zoom in on the institutional framework and the organizational constellations under specific socio-historical conditions and focus on situative encounters between the individuals who make up the universe of interest to us as sociologists—namely, the social world.*”¹¹ These authors acknowledge the heterogeneity of older adults and study them in a naturalistic setting without ascribing them qualities related to the third or fourth age.

¹⁰ No page numbers are listed in this publication.

¹¹ Two footnotes from quotation removed.

4 Discussion

The results indicate that older adults are represented as responsible for many problems. They are viewed as fourth agers or potential fourth agers who could, with the right tools, delay or fix some of the inherent problems associated with older age, i.e. one's own potential frailty, being burdensome to others, and being problematic for society. This discourse assumes the malleability of aging: with the appropriate tools, older adults are able to prevent or fix their older bodies from decay. It hereby confirms Peine and Neven's (2019) argument that new technologies in elder care serve an interventionist logic. Social robots ought to intervene with the aging process to "save" older adults from themselves, and to "save" society from older adults. Relating this statement to the discussed literature on social gerontology, this discourse aligns with theories that acknowledge the importance of making the "right" lifestyle choices in order to age "successfully". Social robots are key in this narrative of self-enhancement, because they are seen as "enabling technologies". It would activate older adults' inactive lives. However, this narrative is not unproblematic. Representing older adults as frail and care dependent by default yet fixable with technologies reduces older people to potential burdensome care recipients. This does not only reflect the ageist assumption that older adults are by definition frail, miserable, fourth agers, but also calls on the responsibility of older adults to "fix" themselves. It is exactly this responsibility of the older individual that serves a neo-liberal ideology. These representations could be seen as a disciplinary strategy in a Foucauldian sense as echoed by Mikkelsen (2017) and Katz (2000). Instead of shifting care responsibilities to the welfare state, older adults are expected to help themselves with social robots to not burden society, others, and themselves. In other words, aging is represented as inherently troublesome, though with the help of "enabling technologies", the individual is imagined to "fix" older age, thereby allocating care responsibilities away from the welfare state. An active older adult, albeit with the help of technologies, is a nonintrusive older adult that does not require too much help from caregivers and the state, and is, therefore, inexpensive. Additionally, the representation about the collective fourth age specifically addresses economic problems with the anticipated demographic changes. The representations of older adults in the field of HRI, not only hold the individual responsible for their own care provision, older adults are also seen as triggers of economic problems. From a theoretical point of view, this means that it is necessary to understand the social construction of new technologies in terms of ethics.

As constructing and studying technologies is a social activity, one needs to be aware of the bias that might slip in that could potentially inform the technological script. One suggestion could be to move away from the essentialist distinction of the third/fourth age as very few cases did. The publications that included such counternarratives were written by authors coming from academic traditions that typically are more sensitive to bias and normativity. Therefore, this paper emphasizes the importance of including perspectives from STS and Critical Robotics Research in a field that otherwise follows an interventionist logic. This would make it possible to critically assess the necessity of new technologies and how they relate to their prospective users. Even though the data used for this paper were fairly robust in terms of theoretical saturation for studies that followed an interventionist logic, one limitation in this research is its sample. Due to feasibility issues, the sample was restricted to a few search terms that were reflected in the publication's title. Furthermore, the sample disproportionately includes studies rooted in positivism. This could have to do with the strict sampling criteria (e.g., the selected databases probably do not include many studies in STS or postphenomenology) or that ever since the sampling procedure ended (in June 2018), more studies in STS could have emerged, which could have provided a bigger base for a counternarrative.

5 Conclusion

This paper started out by stating that it is necessary to understand representations of older adults in the field of HRI because of its potential bias. From a theoretical point of view, it builds on the idea of social constructivism. Studying and designing an artifact is not an inherently straightforward activity, and given the relevance of scholarly HRI researchers, it was deemed necessary to understand this bias and its meaning. Results show that the field represents older adults in an ageist and a neoliberal manner with very few counternarratives. The field ought to be aware of the bias it is reproducing. If the HRI community is serious about creating social robots in elder care for social good and ultimately for a better future, it needs to take its prospective users more seriously.

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References

- Abbey R, Hyde S (2009) No country for older people? Age and the digital divide. *J Inf Commun Ethics Soc* 7:225–242
- Akrich M (1992) The de-scription of technical objects. In: Bijker WE, Law J (eds) *Shaping technology/building: society studies in sociotechnical change*. MIT Press
- Bartl A, Bosch S, Brandt M et al (2016) The influence of a social robot's persona on how it is perceived and accepted by elderly users. In: Agah A, Cabibihan JJ, Howard AM et al (eds) *Social robotics*. Springer International Publishing
- Bijker WE (2010) How is technology made?—that is the question! *Camb J Econ* 34:63–76
- Boumans R, van Meulen F, Hindriks K et al (2018) Proof of concept of a social robot for patient reported outcome measurements in elderly persons. In: *Companion of the 2018 ACM/IEEE International Conference on Human-Robot Interaction*. ACM, Chicago, pp 73–74
- Bruno B, Mastrogiorganni F, Sgorbissa A (2013) Functional requirements and design issues for a socially assistive robot for elderly people with mild cognitive impairments. 2013 IEEE RO-MAN. IEEE, Gyeongju, pp 768–773
- Bülöw MH, Söderqvist T (2014) Successful ageing: a historical overview and critical analysis of a successful concept. *J Aging Studies* 31:139–149
- Cruz-Sandoval D, Favela J, Sandoval EB (2018) Strategies to facilitate the acceptance of a social robot by people with Dementia. In: *Companion of the 2018 ACM/IEEE International Conference on Human-Robot Interaction*. ACM, Chicago IL USA, pp 95–96
- Fernandes FE, Do HM, Muniraju K et al (2017) Cognitive orientation assessment for older adults using social robots. In: 2017 IEEE International Conference on Robotics and Biomimetics (ROBIO). IEEE, Macau, pp 196–201
- Friemel TN (2016) The digital divide has grown old: determinants of a digital divide among seniors. *New Media Soc* 18:313–331
- Given-Wilson T, Legay A, Sedwards S (2017) Information security, privacy, and trust in social robotic assistants for older adults. In: Tryfonas T (ed) *Human aspects of information security, privacy and trust*. Springer International Publishing
- Heerink M, Kröse B, Evers V et al (2008) The influence of social presence on acceptance of a companion robot by older people. *J Phys Agents* 2:33–40
- Hyysalo S, Johnson M (2016) User representation: a journey towards conceptual maturation. In: Hyysalo S, Jensen TE, Oudshoorn N (eds) *The new production of users*. Routledge
- Jenkins S, Draper H (2015) Care, monitoring, and companionship: views on care robots from older people and their carers. *Int J Soc Robot* 7:673–683
- Kargar BAH, Mahoor MH (2017) A pilot study on the eBear socially assistive robot: Implication for interacting with elderly people with moderate depression. In: 2017 IEEE-RAS 17th International Conference on Humanoid Robotics (Humanoids), pp 756–762
- Katz S (2000) Busy bodies: activity, aging, and the management of everyday life. *J Aging Studies* 14:135–152
- Khaksar SMS, Khosla R, Chu M-T (2015) Socially assistive robots in service innovation context to improve aged-care quality: a grounded theory approach. In: 2015 IEEE 7th International Conference on Cybernetics and Intelligent Systems (CIS) and IEEE Conference on Robotics, Automation and Mechatronics (RAM). IEEE, Siem Reap, pp 161–166
- Khosla R, Chu MT, Nguyen K (2013) Enhancing emotional well being of elderly using assistive social robots in Australia. In: 2013 International Conference on Biometrics and Kansei Engineering. Tokyo, pp 41–46
- Laslett P (1991) *A fresh map of life: the emergence of the third age*. Harvard University Press, Harvard
- Looije R, Neerincx MA, Cnossen F (2010) Persuasive robotic assistant for health self-management of older adults: design and evaluation of social behaviors. *Int J Hum Comput Stud* 68:386–397
- Lüders M, Brandtzæg PB (2017) 'My children tell me it's so simple': a mixed-methods approach to understand older non-users' perceptions of social networking sites. *New Media Soc* 19:181–198
- Mikkelsen HH (2017) Never too late for pleasure: aging, neoliberalism, and the politics of potentiality in Denmark: never too late for pleasure. *Am Ethnol* 44:646–656
- Neven L, Leeson CAP (2015) Beyond determinism: understanding actual use of social robots by older people. In: Prendergast D, Garattini C (eds) *Aging and the digital life course*. Berghahn Books
- Neven L, Peine A (2017) From triple win to triple sin: how a problematic future discourse is shaping the way people age with technology. *Societies*
- Pavolini E, Ranci C (2013) Reforms in long-term care policies in europe: an introduction. In: Ranci C, Pavolini E (eds) *Reforms in long-term care policies in Europe*. Springer, New York
- Peine A, Neven L (2019) From intervention to co-constitution: new directions in theorizing about aging and technology. *Gerontologist* 59:15–21
- Pfadenhauer M, Dukac C (2015) Robot caregiver or robot-supported caregiving? *Int J Soc Robot* 7:393–406
- Pinch TJ, Bijker WE (1984) The social construction of facts and artefacts: or how the sociology of science and the sociology of technology might benefit each other. *Soc Stud Sci* 14:399–441
- Pino M, Granata C, Legouverneur G et al (2012) Assessing design features of a graphical user interface for a social assistive robot for older adults with cognitive impairment. *Gerontechnology* 11:383–383
- Reppou SE, Tsardoulas EG, Kintsakis AM et al (2016) RAPP: a robotic-oriented ecosystem for delivering smart user empowering applications for older people. *Int J Soc Robot* 8:539–552
- Sakamoto K, Fern SALC, Han L et al (2016) Psychographic profiling for use in assistive social robots for the elderly. In: Kubota N, Kiguchi K, Liu H et al (eds) *Intelligent robotics and applications*. Springer International Publishing
- Salichs MA, Encinar IP, Salichs E et al (2016) Study of scenarios and technical requirements of a social assistive robot for Alzheimer's disease patients and their caregivers. *Int J Soc Robot* 8:85–102
- Siciliano B, Khatib O (2008) *Springer handbook of robotics*. Springer
- Stafford RQ, MacDonald BA, Jayawardena C et al (2014) Does the robot have a mind? Mind perception and attitudes towards robots predict use of an eldercare robot. *Int J Soc Robot* 6:17–32
- Sung HC, Chang SM, Chin MY et al (2015) Robot-assisted therapy for improving social interactions and activity participation

- among institutionalized older adults: a pilot study: robot therapy for older adults. *Asia Pac Psychiatry* 7:1–6
- Tapus A, Mataric M (2008) Socially assistive robotic music therapist for maintaining attention of older adults with cognitive impairments. In: *Proceedings of AAAI fall symposium on AI in elder-care: new solutions to old problems*, Arlington
- Wada K, Shibata T, Saito T, Tanie K (2003) Psychological, physiological and social effects to elderly people by robot assisted activity at a health service facility for the aged. In: *Proceedings 2003 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2003)*. IEEE, Kobe, pp 272–277
- Wada K, Shibata T, Saito T et al (2005) Psychological and social effects of one year robot assisted activity on elderly people at a health service facility for the aged. In: *Proceedings of the 2005 IEEE International Conference on Robotics and Automation*. IEEE, Barcelona, pp 2785–2790
- Woolgar S (1990) Configuring the user: the case of usability trials. *Sociol Rev* 38:58–99
- Zlatintsi A, Rodomagoulakis I, Pitsikalis V et al (2017) Social human–robot interaction for the elderly: two real-life use cases. In: *Proceedings of the companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction*. ACM, Vienna, pp 335–336

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