CHAPTER

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Carebots for eldercare: Technology, ethics, and implications

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Introduction: The need for independence

The population of the world is rapidly aging. In the foreseeable future, all developed societies will be "aging societies," where the number of people in later life stages will vastly outweigh the number being born (Harper, 2014). These demographic changes, especially in the United States (see Fig. 1), may introduce additional demands with regard to providing care for the elderly which cannot be met by human caregivers. Additionally, the prevalence of age-related conditions requiring care is on the rise—as well as the number of people with conditions requiring around-the-clock care, such as dementia. According to the World Health Organization, there were 7.7 million new cases of dementia in 2010, or one new case every 4 seconds (WHO, 2012). To put future developments into perspective, there were 36 million people living with dementia worldwide in 2010, and by 2030, this number will increase to 66 million. By 2050, this number will further increase to 115 million (Batsch & Mittelman, 2012). Even when intellectual capacities are spared in old age, the increasing loss of physical faculties means that the elderly need either human care or some form of assistive technology.

There are currently a number of consumer technologies that allow the elderly to live a somewhat more independent and self-sufficient lifestyle in their own homes than they otherwise would have been able to without access to such technology. We may consider the hypothetical example of a person named Linda who is approaching the age that she may start to
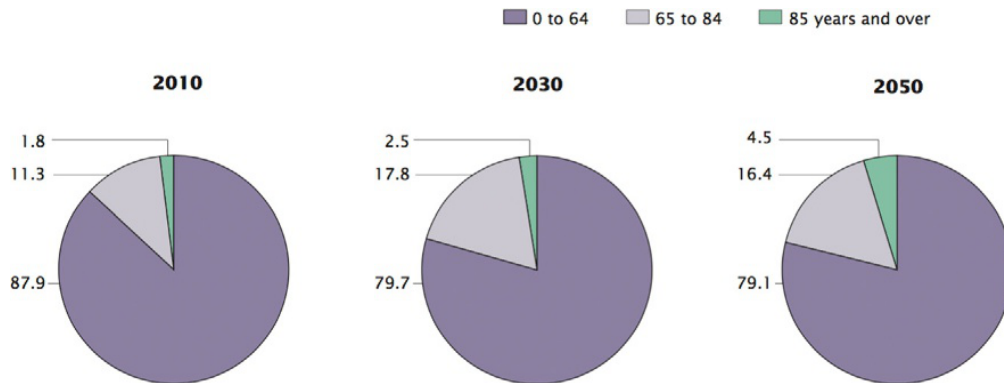
FIG. 1   Percent distribution of the US population by age group: 2010, 2030, and 2050. *Source: US Census Bureau, 2012 Population Estimates, and 2012 National Projections.*

consider the choice of relocating to a retirement home or assisted living facility. A number of factors may be at play in Linda's decision-making process. She may have advancing health issues or problems with locomotion that prevent her from caring for herself like she used to. She may live in an area with inadequate public transportation, and she may be experiencing deteriorating eyesight or hand-eye coordination that makes driving less convenient and more dangerous than it used to be, forcing her to consider alternative forms of transportation to continue to run errands and socialize. She may be starting to find it difficult to get enough exercise or to properly monitor her own health. Linda may also be experiencing a number of fears and emotional reservations about continuing to live at home alone as she continues to age. However, all of these factors may be overridden by her strong desire to avoid displacement and stay at home, where she feels most comfortable.

There are a number of currently available consumer technologies that may allow Linda to allay her concerns and fears and grant her with the ability to continue to live at home. She may, for instance, purchase a car with self-driving capabilities that—while not yet fully autonomous—may have some automation features like radar-adjusted cruise control, blind-spot monitoring, and lane-centering that would take some of the stress and guesswork out of driving for Linda, ensuring that she may continue to have reliable transportation without unacceptable safety risks to herself or others even in an area with insufficient public transportation. Self-driving technology would allow Linda to continue to run her own errands and would prevent the potential isolation from social activities that she may have experienced without adequate transportation options. She may also already carry a smartphone with a smart watch that would allow her to monitor some vital signs, including her heart rate, allowing

her immediate access to emergency or telehealth services via a video call with an offsite physician. Telehealth services made available to Linda may allow her to talk to a physician more frequently than she otherwise would have and may allow her to seek a more convenient professional opinion on health matters via telemedicine that might have otherwise required an inconvenient and expensive trip to the emergency room or future appointment with a doctor. Linda may opt to place virtual assistant devices such as a Google Home or Amazon Alexa throughout her home that would allow her to call at any time for help with a simple voice command. If she fears an occurrence like a seizure that may prevent her from calling for help, and if she has friends and family that she trusts to monitor her remotely, she may even opt to place internet-connected cameras with microphones strategically in her house to maintain a desired level of privacy while still allowing friends and family to keep an eye on her. Finally, to attain regular exercise and entertainment, Linda may use video games with motion-activated peripherals or virtual reality headsets to participate in simulated activities with real physical movements, such as virtual tennis or rhythm-based video games.

Linda's example illustrates some important considerations about carebots that we will examine in this chapter. First is the notion that a "carebot" is not limited to the realm of an anthropomorphic physical presence like a pop-culture understanding of robotics technology might lead one to hold in mind. A carebot does not necessarily have to have bipedal ambulation with two legs, two arms, and a head with a human-like face capable of mimicking emotional expressions. Arguably, the most important part of a carebot is the software that runs it and allows it to make "decisions" about the needs of its user, and no purpose-built robotics hardware is necessary in order for this software to run. As we will see in the next section, a "carebot" could arguably be as simple as an app on a smartphone. That brings us to the second consideration that Linda's example allows us to address, which is that there are currently numerous commercially available consumer technologies that may be used to help provide care for the elderly. This raises a number of questions. Can these consumer technologies really be considered carebots? If so, are the ethical implications of these technologies adequately addressed in the literature around carebots? The answer to these questions may lead us to a different and more generous understanding of the ethics of carebots. For instance, if no one would question Linda's right to choose to download an app that helps her remember when she needs to take medications important to her health, why would her choice to utilize a more advanced robotics technology to help her with both that and additional care-related tasks be questioned? The section below on the ethical considerations around carebots may help shed light on these questions.

Carebots: The state of the art

Linda's hypothetical example shows us how even commonly available consumer technologies can be used as functional equivalents for a number of caregiving services while maintaining independence and self-sufficiency and without requiring the individual to relocate to a caregiving facility. Pepito, Locsin, and Constantino (2019) provide a thorough overview of the kinds of consumer electronics, Internet of Things (IoT) devices, apps, and robots currently available for the purposes of providing care for the elderly. In addition to these consumer technologies, there are a growing number of robotic technologies currently available, and in developmental phases that are designed to provide additional levels of care to the elderly. These carebots represent a range of capabilities and vary in the level of services they may offer to the elderly. The simplest ones currently available are in the same price range as commonly available consumer electronics and offer virtual assistance services but with an emotive, interactive design. Electronic devices like Jibo (Robotics Today, 2015) and ElliQ (Haselton, 2018) sit on a desktop or surface and respond to voice commands and interact with their users. Though simple in design, Jibo may be anthropomorphized and elicit an emotional response from its user (Camp, 2019). PARO, a robot designed to look like a harp seal that can mimic emotional responses, is used as a companion and provides emotional and social engagement for the elderly (Aminuddin, Sharkey, & Levita, 2016).

Increasingly complex carebots are capable of self-locomotion, can navigate their environment, and can provide additional levels of interaction with people. Stevie is a human-sized robot incorporating an anthropomorphic design with electronic displays that represent facial features and emotions. The services Stevie may offer for eldercare include medication reminders, simple conversation, and contacting emergency services should the user become unresponsive (McGinn, Bourke, Murtagh, Donovan, & Cullinan, 2019). Robots like Moxi incorporate a face-like display and a robotic arm to manipulate the environment around it. Moxi is even capable of performing routine tasks in a hospital setting, like bringing supplies from a central storage room to a patient's room, thus freeing up human hospital staff for more complicated tasks (Ackerman, 2018). Robots like Robear are designed to tackle labor-intensive tasks associated with eldercare like helping people get out of bed, stand up, or get into and out of a wheelchair (Szondy, 2015). Robots like Pearl remind patients and retirement home residents about routine activities and guide the elderly through their environment (Charova, Schaeffer, & Garron, 2011). Pearl is unintrusive and made to look obviously robotic so as not to induce discomfort (or deception) regarding its human-like appearance (see Fig. 2). This becomes an important factor when considering the ethical implications of carebots.

FIG. 2   Image of Pearl, the Nursebot. *Courtesy: National Science Foundation.*

Ethical and social concerns about carebots

While present-day carebots represent a range of capabilities that may help care for the elderly, they do not currently represent a replacement for human caregivers—certainly not for specialized care, like that needed for dementia patients and those with paralysis. They could, however, help the elderly to maintain an independent lifestyle for a longer period of time and provide basic levels of routine assistance and care that could help extend a potentially inadequately staffed and funded caregiving industry. Though possibly beneficial for the elderly, their families, their caregivers, and the communities they belong to, carebots do raise some ethical and social concerns. A systematic review of the argument-based ethics literature around carebots conducted by Vandemeulebroucke and colleagues reveals a number of ethical concerns about carebots and breaks them down into four ethical approaches: the deontological, the principlist, the objective-list, and the care-ethical approaches (Vandemeulebroucke, de Casterle, & Gastmans, 2018), all of which are detailed below.

Deontological concerns

The first approach identified by Vandemeulebroucke and colleagues analyzes carebots with a deontological lens. Deontology (from the Greek *Deon*, which means "duty" or "obligation") is an influential moral theory that prohibits certain actions as wrong and is best understood in layperson's terms as claiming that the "ends do not justify the means." Some ethical objections to carebots raised by the deontological approach include issues of autonomy, dignity, deception, and social isolation. Authors taking this approach argue that the introduction of carebots "into aged-care settings leads to inappropriately viewing older adults as means to ends" (Vandemeulebroucke et al., 2018, p. 19). In other words, caring for the elderly should not be treated just as a burden on society that robots could solve, and should robotic care be implemented, the elderly being cared for must benefit from the arrangement.[a] Deception is a focus of some deontological analysis of carebots. Some authors of literature on carebots, especially Sharkey and Sharkey (2011) and Sparrow and Sparrow (2006), argue that the use of carebots is a kind of deception—especially when robots are presented with anthropomorphic features that mimic emotions. As is seen in a number of the technologies covered in the previous section, we may be tricking the elderly into feeling that they are getting something they are not: *cared for* by robots that are, in fact, incapable of *caring*. Sparrow & Sparrow (2006, p. 155) state that "thinking that an expensive and sophisticated electronic toy is really our friend is sentimentality of a sort we should avoid." Finally, the deontological approach raises concerns about the social isolation that may arise as a result of the use of carebots—and, conversely, the positive effects carebots may provide in helping the elderly remain connected to their communities. While homebound individuals receiving care from robots may become isolated from society, carebots may also "relieve human caregivers' workloads, providing them more time to focus on improving older adults' quality of life" (Vandemeulebroucke et al., 2018, p. 20).

Notably lacking from the deontological approach to analysis of the ethics of carebots is consideration for the wants and needs of the elderly themselves. Though approaching carebots with well-intentioned skepticism, some utilizing the deontological approach (such as Sharkey & Sharkey) seem to take a somewhat paternalistic view toward the elderly. Ironically, while those taking the deontological approach are concerned about the objectification of the elderly, there seems to be little

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[a]A salient ethical issue in this context is the motives of manufacturers of carebots, and we thank an anonymous reviewer for pointing this out. However, due to reasons of space, we can only agree that future work needs to address this issue as discussing it here would take us far away from the immediate topic of the chapter.

consideration for the ability of those in need of care to themselves make decisions about their own care. Arguments about deception and truth, for instance, seem to stereotypically assume that the elderly can be easily fooled into thinking that carebots are capable of empathizing and providing genuine emotion and care. However, people of all ages may anthropomorphize and grow attached to objects, like anyone who has ever named a car and attributed to it personality quirks that truly represent manufacturing defects. In fact, there is ample evidence for this effect of anthropomorphizing and even ascribing personhood to inanimate objects (see Farah & Helberlein, 2007). Despite this, the (arguably deontological) moral unease some people feel about human-like robots seems to have prompted the development of obviously nonhumanoid robots, such as Pearl (see discussion above).

Arguments from social isolation seem to misrepresent the elderly as individuals incapable of advocating for their own needs and acting in their own best interests—while interacting with a carebot may provide some very basic level of positive psychosocial stimulation, elders not suffering from significant cognitive impairment should be assumed capable of arranging for social activities to provide necessary mental stimulation. Additionally, any carebots or technologies that would allow elders to stay in their own homes and communities rather than relocating to caregiving facilities would mean that those individuals would experience less severing of social connections that would have otherwise resulted from a forced move. The use of carebots could therefore actually result in greater connectedness for those receiving care.

Principlist concerns

The principlist approaches to the ethics of carebots identified by Vandemeulebroucke and colleagues are viewed by the authors as "practical translations of the deontological approach" (20)—these analyses take essentially deontological arguments about carebots and provide practical suggestions to address the stated concerns. Principlism is an established approach in biomedical ethics, based on a set of values that medical professionals can refer to in the case of confusion or conflict, which include (1) respect for autonomy, (2) beneficence, (3) nonmaleficence (and in this context safety), and (4) justice (Beauchamp & Childress, 2009). The principlist approach may be seen as more optimistic, recognizing the potential benefits of carebots and suggesting practical solutions to the legitimate ethical concerns.

The principlist answer to questions of autonomy for users of carebots is that the users must be educated about the carebots' capabilities and the role they play in their lives. Users of carebots must be cognizant of the

privacy concerns that may arise from the use of carebots, and, furthermore, all carebots must comply with relevant privacy laws, such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States and the General Data Protection Regulation (GDPR) in the European Union. Addressing the issue of deception, Feil-Seifer and Matarić (2011) point out that concerns about deception should be tempered as people get to know and understand their carebots, as with any other emerging advanced technology.

Addressing issues of beneficence, as well as safety and nonmaleficence, principlist arguments handle one of the most tangible concerns about carebots: namely, the risk of being physically or emotionally hurt. Various commentators discussing the ethics of carebots stress that carebots must be thoroughly vetted not only to prevent harm but also to promote "physical, cognitive and social wellbeing, strengthening older adults' autonomy" (Vandemeulebroucke et al., 2018, p. 20). For example, one way that a carebot may indirectly and unintentionally cause harm would be if the user grows attached or accustomed to the services of a carebot that then must be taken away for some reason (e.g., a government-funded implementation program is no longer active, or the technology is no longer supported, as in the previously mentioned case of Jibo).

Finally, the principlist approach to the ethics of carebots considers the issue of justice, particularly the fair distribution of resources. Some commentators rightly point out that carebots can be expensive; the cost of owning and operating them may fluctuate; and different countries have different healthcare systems, which could result in unequal access to carebot technology. While technically true, the usefulness of this line of questioning around the use of carebots for eldercare is limited because the same reasoning applies to nonrobot care. Employing a human caregiver may be expensive, especially as insufficient numbers of people are being trained to meet the needs of a rapidly aging populace. Different countries have different healthcare systems, which means that some people may have access to subsidized human eldercare while others may not. In short, while usage of carebots does denote a departure from the *status quo*, nothing about carebots from an economic justice perspective is unique from any other emerging technology, and no line of argumentation from this approach would lead to a rational conclusion that carebots should not be employed where they could help meet the needs of elders in need of care in a way that is beneficial for the user and their community. In fact, early adoption of carebots may actually lead to mass production and reduction of costs through economies of scale, further decreasing the barriers to access.

In addition to issues of economic justice, carebots also present with potential issues of social justice, especially with regard to the notion of inherent biases of human programmers carrying over into the

functionality of the software itself. For instance, an algorithm developed to predict whether a defendant on trial for a crime would be likely to become a repeat offender has been shown to exhibit racial bias (Angwin, Larson, Mattu, & Kirchner, 2016). While robots, the software that runs them, and the computer algorithms that underlie such software may seem inherently objective and mathematical, it is important to consider that there are instances where supposedly objective and morally neutral robots may exhibit biased or prejudiced behaviors inherited from their human programmers.

Objective-list approach concerns

Crisp (2017) states that "objective list theories are usually understood as theories which list items constituting well-being that consist neither merely in pleasurable experience nor in desire-satisfaction." Those considering the ethical implications of carebots using an objective-list approach attempt to develop an objective account of care "by putting forward several capabilities or 'goods' that can be reached or supported by care practices" (Vandemeulebroucke et al., 2018, p. 21). Vandemeulebroucke and colleagues explain that…

> [M]ost authors [taking the objective-list approach] specifically refer to Nussbaum's book *Frontiers of Justice* (2006, p. 76–77), in which she compiles a list of 10 central human capabilities representing thresholds of achievement that when breached, lead to a dignified and flourishing life. These are named: 'life'; 'bodily health'; 'bodily integrity'; 'senses, imagination, and thought'; 'emotions'; 'practical reason'; 'affiliation'; 'other species'; 'play'; 'control over one's environment'.

Carebots are thus evaluated based on the standard of care that "focuses on organizing care that creates opportunities for achieving these capabilities" (Vandemeulebroucke et al., 2018). However, the capabilities that must be met to lead to a dignified and fulfilling life must be considered from the viewpoint of different cultures, and the possibility that these requirements may evolve over time needs to be addressed. Nonetheless, some argue that carebots "must create opportunities for older adults and their caregivers to fulfill their capabilities" (Vandemeulebroucke et al., 2018).

What may be unclear about the capabilities objective-list approach is how the usage of carebots vs. the employment of traditional human caregivers may impact the ability of the cared-for to meet the capabilities that should lead to a rewarding and dignified lifestyle. One may consider the earlier example of Linda, the older adult who—thanks to modern and near-future caregiving technology—would be free to stay in her home rather than moving to a caregiving facility earlier than she otherwise

would have been forced to without the availability of such technology. Someone like Linda, when faced with the possibility of either (a) staying in their home in their community and utilizing the services of a carebot or (b) being transferred to a traditional caregiving facility staffed with human caregivers, may opt to stay at home and utilize the services of a carebot and subsequently experience a better quality of life than she otherwise would have had she transferred to the care facility. Ultimately, being under the care of other humans leaves individuals vulnerable to the possibility that their human caregivers may not act in their best interests and may indeed act maleficently toward them. Indeed, there is ample evidence of instances of elder abuse and neglect (Cooper, Selwood, & Livingston, 2008), and some of these are truly shocking, such as the case of a woman with dementia being eaten alive by scabies in a for-profit nursing home (Phillips, 2018).[b] If the choice is between utilizing a morally neutral carebot (to the extent that currently available and near-future carebots are not capable of moral judgment or acting maleficently) or living under the thumb of an abusive human caregiver, utilizing a carebot would lead to better fulfillment of the individual's capabilities, thus representing a morally preferable arrangement.

Authors engaging in the objective-list line of ethical discourse regarding carebots also tend to emphasize the issue of deception—namely, that older adults utilizing carebots may have a misconception of the true abilities of the carebots. A carebot's deceptive nature, in this line of reasoning, may be as simple as having a digitally reproduced smile that does not, in fact, reflect a true underlying human emotion. This may be of particular importance when considering the care of patients with dementia or other cognitive impairments. However, when considering the usage of carebots by older individuals without impaired cognition, the emphasis on deception may appear somewhat paternalistic. Human beings have active imaginations and may project psychological states or personalities on inanimate objects, animals, or even other people that do not reflect the reality of the experience of interacting with the projected-upon thing or individual (see Farah & Helberlein, 2007). In many cases, this may be perfectly harmless or may even be a form of play, which is actually one of the

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[b]It should be made clear that this kind of tragic occurrence could still come to pass under the supervision of carebots—especially if the robots are, for instance, not capable of detecting such an infestation. However, the important distinction here, we believe, is that robots are not capable of moral judgments and thus not capable of acting maleficently, whereas a human caregiver knowingly allowing their patients to come to harm is acting with maleficence. This distinction is important to the ensuing arguments. It is true, however, that neutral moral agents such as robots may still exhibit apparently immoral characteristics. We thank an anonymous reviewer for prompting us to make this clear.

capabilities authors utilizing the objective-list approach identify as a means to leading a fulfilling life.

The best response to an objective-list approach may be a case-by-case analysis of carebot use among individuals. The question then becomes "does the use of a carebot by this individual ultimately result in their leading a better life?" If the answer is yes, then the usage of a carebot by that individual is not to be discouraged. Otherwise, the individual in need of care may indeed be better off with a human caregiver. Ultimately, as long as the individual in need of care is sound of mind, the decision of how they wish to receive that care should be up to them.

Ethics of care concerns

The final category of ethical analysis of carebots identified by Vandemeulebroucke and colleagues is arguments related to care-ethical approaches. Ethics of Care was first introduced in the work of Carol Gilligan (1982) and proved to be a defining influence that propelled work in feminist ethics. Gilligan's theory posits that males and females have different voices that guide their moral behaviors. For males, the voice that is dominant is the one that is logical and concerned with ideas of equality, autonomy, justice, and individualism. The voice that is dominant in females is the voice that speaks up on issues of others—those outside of the individual—and is called the "interpersonal voice." Care means safety for others and caring about their issues (Muuss, 1988). Gilligan noted that women more often than men focus on the idea of selfishness and responsibility in their moral thinking (Gilligan, 1982).

According to Vandemeulebroucke and colleagues, "[c]are-ethical approaches start from the particular care relationship between caregivers and care receivers, and progressively widen their scope to include a contextual level and then a political level. They stress that meaningful care relationships consist of 'caring about' and 'caring for' someone" (22). The major concern care ethicists raise is that robots cannot really *care*; thus the care relationship, which is essential for feminine morality, gets disrupted and becomes meaningless. Replacing real caregivers with robots is seen as detrimental for society. Beyond those concerns, issues that have been raised include objectification of elders (objectification in general being a major concern in feminist literature), deception, and social isolation. There is another important dimension of the care-based approach to the ethical assessment of carebots. Namely, some feminist literature has addressed the economic and political context of "feminized jobs" such as caregiving (see Standing, 1989): these jobs tend to be the least respected and paid in any given society. Thus even though the instrumental and economic contribution (in terms of increased efficiency and productivity) of

carebots in aged care may be a good thing, it may contribute to additional de-valuation of the work provided by women.

Thus when considering any given carebot technology on a case-by-case basis, special attention needs to be given to the potential of their widespread use to further marginalize certain groups. It is our position that human caregivers are important and deserve to be compensated for the skilled services they render, and that it would be better that any large-scale implementation of carebot technology does not displace or devalue human caregivers. Considering demographic trends that may lead to a gap between the number of caregivers available and the amount of caregiving services required by the elderly, however, carebot technology may help fill this gap or serve as an extension or augmentation of the services provided by human caregivers. If carebots are used to assist nurses and reduce their work loads, they may lead to an overall reduction in nurse burnout, which has been shown to decrease quality of care (Poghosyan, Clarke, Finlayson, & Aiken, 2010). However, if the caregiving industry utilized carebots to replace nurses completely, we would agree with care ethics critics that it would be unethical to do so.

Toward an ethical consensus on carebots

As is readily apparent, deception, objectification, social isolation, and displacement or marginalization of humans are crucial concerns that are recognized by ethicists. Indeed, these are valid concerns, and some carebot developers and funding bodies in the United States (such as the National Science Foundation) seem to be taking them seriously (consider the example of Pearl, above). Thus, as mentioned previously, most insightful ethical evaluation of carebots cannot be done in general, but on a case-by-case basis. However, there is one general point we would like to stress. Namely, unlike humans, carebots will certainly not be intentionally engaged in elder abuse.[c] The crucial question that needs to be answered then is whether carebots can help prevent elder neglect. Suppose Linda heard about the shocking stories in nursing homes and is hoping to be cared for by carebot technology as opposed to human

[c]The issue remains as to who should be held accountable if mistakes do occur while utilizing carebots and a human subsequently comes to harm. The issue of who should be held responsible for a robot's actions is the subject of ongoing debate, especially with regard to legal issues associated with autonomous cars (Lin, 2016). We believe the conclusion about who is morally responsible for a robot's actions is far from clear, and not something we can establish within the scope of this chapter, but we do thank an anonymous reviewer for constructive comments that prompted us to reflect on this issue.

caregivers. She thinks she is experiencing mild cognitive decline, while in fact she is in the early stages of dementia. If she had access to a carebot like Pearl, would she be better off and able to stay in her home longer (which is her preference)?

We think that she would, and not only would this be beneficial in terms of her health outcomes, it would provide an arrangement more respectful of her autonomy. Namely, even though there is a widespread assumption in the literature that people living with dementia are not capable of maintaining any level of basic autonomy (see, e.g., Dworkin, 1993), which in turn leads to their stigmatization (see Dubljević, 2019), part of the problem of maintaining day-to-day functioning is actually the standard response society has to people living with dementia. Dementia does cause memory issues and learning difficulties. Thus when people with dementia are placed in a completely new nursing home environment, which does not have the familiar cues they are used to, this actually increases their cognitive difficulties (Batsch & Mittelman, 2012). Conversely, having access to a carebot like Pearl, which would provide much needed reminders and facilitate continued living in the familiar environment of their home would not only allow dementia patients to choose to stay at home but would also prolong the time they may maintain relatively intact functioning. But why should we care about an individual's choice in the matter if they have dementia?

Contrary to the traditional view of autonomy, which was heavily predicated on memory and cognitive capacities, newer models of autonomy, which better reflect neuroscientific evidence, place the crucial capacities not on cognition, but on valuing (see Jaworska, 1999) and volition (Dubljević, 2013). According to Jaworska, dementia patients in early stages of the disease progression are in fact autonomous: "[…] in the context of dementia […] , so long as [the person] still holds values, he is capable of self-governance and can form new critical interests" (Jaworska, 1999, p. 134). Since Linda from our example clearly has values, has no issues with volitional disturbances, and merely has cognitive deficits that are remediable with the use of carebots, there is an ethical obligation to respect her autonomy and provide her with the tools to maintain that as long as possible. An argument can be made that anthropomorphic robots might be problematic in cases like Linda's, but nursebots such as Pearl (and perhaps virtual assistants) could offset such concerns and provide help with managing medication use and even financial matters (e.g., reminders to pay the bills, making sure they are in fact paid, etc.). Of course, since dementia is a progressive illness, Linda will eventually need to be cared for in an assisted living facility, but only in the later stages when the disease starts affecting her socio-moral judgment and volitional capacities (see Dubljević, 2020). This does not completely solve the issues of the poor state of affairs in certain nursing homes, but arguably, with

more people (like Linda) being able to stay at home, the facilities with human caregivers would not be as overcrowded and understaffed, and both of these issues contribute to de facto neglect of elders. Moreover, if carebots are used in such assisted living facilities, they could potentially record (and report) instances of elder abuse, thus helping reduce a major social concern.

However, some might not be convinced with the argument from newer conceptions of autonomy and insist that the only people whose autonomy should be respected are those in full control of their cognitive capacities (e.g., memory). In fact, previously we have argued that elders *not suffering from significant cognitive impairment* should be assumed capable of arranging for social activities to provide necessary mental stimulation. Now we wish to extend the argument from autonomy to the elderly in early stages of dementia, which may encounter resistance from skeptics. To those we submit that they are prejudiced toward different forms of cognitive capacities that provide "scaffolding" for human autonomy. Consider Clark and Chalmers' hypothetical example of two individuals in New York who have different ways of instantiating their choices and navigating the world: Otto and Inga. They both hear of an intriguing exhibition at the Museum of Modern Art (MOMA). Inga recalls it is on 53rd street and sets off. Otto, however, suffers from early stage dementia, and as a result, he always carries a notebook in which he records information he thinks he may need. He hears of the exhibition at MOMA, reads the address from his notebook, and sets off in this direction (Clark & Chalmers, 1998). Clark and Chalmers argue that Otto's usage of a notebook to find the exhibit is comparable to Inga's usage of her own memory to do the same.[d] Both Inga and Otto have beliefs about where the MOMA is located, and they both retrieve these beliefs somehow to get there. It is just that Otto's beliefs are not stored in his brain—they are stored externally to his body. Effectively, they both are able to use their beliefs to achieve the same result, and thus exercise their autonomy. Now, this is not to say that cognitive capacities are not relevant for autonomy—they certainly are, but this thought experiment serves to point out that the actual exercise of cognitive capacities is what we need to respect in human beings, whether or not they are elderly and suffering from mild cognitive decline or dementia.

[d]As noted by an anonymous reviewer, in this day and age most people use GPS devices and not notebooks. However, two issues need to be noted. First, elderly people like Otto and Inga in the example may be averse to using new technology and resort to notebooks. Second, the point of the argument is that even low-tech external memory storage (e.g., a notebook) may help increase the autonomy of human agents. Conversely, high-tech applications, such as GPS devices and carebots, could also be seen as uncontroversial external means of augmenting human agency and autonomy. See Bauer and Dubljević (2019) for a related discussion.

Arguably, the use of carebots, if freely chosen by a person like Linda, is autonomous in two ways: it flows from her values and unfettered volition, and it helps her maintain a level of cognitive functioning through externalizing memory storage and retrieval. The fact that Otto uses a low-tech tool to help maintain his cognitive functioning whereas Linda uses carebots makes no difference. If we care for and respect *persons*, then we should care for and respect their choice of cognitive scaffolding. Just as it would be cruel and arbitrary to destroy Otto's notebook or deny him access to it, so it would be cruel and arbitrary to deny people like Linda access to carebot technology, especially if it can help them live independently for longer.

However, the skeptics may point out that people in the early stages of dementia cannot be cognizant of privacy concerns that may arise from the use of carebots and may be easily deceived. It will be remembered that this was the caveat introduced in the principlist literature on autonomy in the ethics of carebots, whereas the deception concern has been raised across ethical theories. To this, we respond that this is not an issue that needs to be solved at the level of every single individual living with dementia, but rather may be addressed with "ethical design" (Baldini, Botterman, Neisse, & Tallacchini, 2018) of carebots. Just like computers may be run in "safe mode" that excludes certain functionalities (especially in terms of access to external networks), carebots designed to work with people living with dementia may be programmed to guard their privacy via "embedded protective technological solutions" (Baldini et al., 2018, 913). Also, nonanthropomorphic design of dementia carebots addresses the issue of deception and guarantees that the "ascription of personhood" to inanimate objects is not on a distinctly higher level from someone caring about their new car.

Conclusion

As populations around the world age and human caregivers become more scarce, carebot technology presents itself as a potential solution to this widening needs gap. While many ethical concerns have been raised about carebot technology, there is no general ethical concern that would lead to anything like a moratorium on carebots. While some ethical concerns may persist, especially when concerning individuals who require more advanced caregiving services (such as those with dementia), carebot technology may at the very least be used to help free up human caregivers to provide more specialized care to those in need of it while allowing those without more advanced caregiving needs to lead an independent lifestyle and care for themselves for longer. In fact, once individual sources of moral unease and concern are addressed with ethically informed design,

the use of carebot technology to extend or even replace human caregivers may be a logical solution for meeting the rising demands for providing care for the elderly. The analysis of presently available carebot technology leads us to conclude that developments in the near future will bring about more functions that may be instrumental in providing adequate elder care and extending the autonomy and independent functioning of elders with or without cognitive deficits. When considering the use of carebots to help care for the elderly, it is important to respect the autonomy of individuals who elect to utilize carebot technology. Like any emerging technology, there may be some initial reservations about carebot technology that will eventually subside as individuals opt into the usage of such technology, and it thus becomes more commonplace.

Acknowledgments

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V. Culture, emotion and ethics in human-robot interaction

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