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[Scoping review: The use of social robots in the social professions – ethical considerations]

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Abstract

In this Scoping review, we outline ethical issues with regard to the use of social robots as pertaining to the social professions. Methodologically, a wide range of ethical approaches and conceptualizations are evident in the literature. This methodological richness allowed us to capture a variety of different ethical concerns. While the aim of this review was to remain largely theoretically neutral in reviewing the ethical debate within the field, the value of the different sensibilities arising from different theoretical framework is evident in the richness of concerns identified. Thus, we highlight core themes as well as gaps in the debate

PRoSPERo – Pedagogy of Robotics for the Social Professions in Europe

Scoping review: The use of social robots in the social professions – ethical considerations

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1 Introduction

In this review, we explore ethical considerations regarding the use of social robotics in the social professions (childcare, care of older persons, childhood education and nursing). The paper is written as part of the PRoSPERo project with the goal to underpin the future development of educational resources on social robotics for members of the social professions.

1.1 Context

The development of artificial intelligence and robotics has transformed practices in industry, professional settings and everyday life. Vastly expanded data processing capabilities, the development of user-friendly interfaces for complex information technologies that increasingly enable lay user to engage actively with these technologies, and the possibility of seamless integration of diverse technologies through the Internet of Things have opened up new opportunities for the use of information technology. Social robots are being increasingly envisioned as part of care provision in the social professions and have seen an increased use in various social application contexts. Their entry into those fields has been accompanied by optimism and enthusiasm by some, skepticism and concern by others. Ethical considerations have been a prominent aspect in responses to this new technology. In this review we present

ethical literature regarding social robots that are employed within or close to the practice of the social professions, complemented by some more foundational research on ethical perspectives on social robotics.

1.2 Goals

We will identify trends in the discussion of ethical issues in social robotics, focusing on prominent themes in the literature within the field. Through our reading of the source materials the aim is to (i) scope the field of knowledge in order to inform the PRoSPERo initiative on current research regarding ethics and social robotics and (ii) to point to potential knowledge gaps or underexplored areas of interest, as evident within the research reviewed here, that merit further theoretical attention and empirical research.

2 What are social robots?

Reidsma et al. (2019), in another scoping paper developed for the PRoSPERo consortium, present a pragmatic definition of core characteristics of social robots:

- A social robot operates in a “social space"
- A social robot has a physical embodiment
- A social robot operates on the sense{think{act paradigm, i.e. it has sensors to capture what is happening in the social space, processes this information, and performs an action in the social space on the basis of this information processing.

Following Hegel et. al. (2009), social robots can be described in general terms as embodied socially interactive information technologies that have a social function and manifest this social function in their shape and appearance (2009:3).

Breazeal et al. (2016) specifies this further:

> *“social (or sociable) robots are designed to engage people in an interpersonal manner, often as partners, in order to achieve positive outcomes in domains such as education, therapy, or health, or task-related goals in areas such as coordinated teamwork for manufacturing, search and rescue, domestic chores, and more”* (2016: 1349).

Social robots are designed to facilitate and foster engagement with human users on an interpersonal level in a variety of use contexts, including medical, educational, entertainment, domestic or customer service settings. Social robots show varying degrees of initiative and autonomy in their interaction with human users. They come in different shapes, from the closely anthropomorphic (such as the sex-robot Roxxxy), to the traditional humanoid robots (such as NAO), to zoomorphic (such as the elderly care robot Paro), to more "technical" looking robots (such as the telepresence robot Giraff Plus).

(https://www.robotlab.com/hubfs/Nao%20Power%20V6-1.png; https://telepresencerobots.com/sites/default/files/giraff-telepresence-robot_0.jpg); https://static.independent.co.uk/s3fs-public/thumbnails/image/2017/07/19/15/robot.png?w968; http://www.parorobots.com/images/gallery_us_11_2009/Picture%202-640.jpg;

While robots that interact with humans in a variety of contexts increasingly include some socially interactive functions, for the purpose of this paper we will focus on those robots whose function is primarily that of social interaction and engagement with a human counterpart in domains of activity typical for the social care professions.

2.1 What is robot ethics?

Robot ethics (or "roboethics") is an emerging field of interdisciplinary debate, which considers ethical issues that arise with regard to the design, interpersonal use and societal impact of robots. The field of robot ethics is sometimes subdivided into two areas of inquiry that address different kinds of ethical issues, one foundational, concerning questions about the nature and moral status of artificial moral agents (sometimes also labelled "machine ethics" or "machine morality") and the other application focused, concerning questions about the design of robots, their implementation in practice, and societal responsibilities regarding the management and potential limitation of their use: *"Robot ethics encompasses ethical questions about*

how humans should design, deploy, and treat robots; machine morality encompasses questions about what moral capacities a robot should have and how these capacities could be computationally implemented" (Malle, 2015: 243). The purpose of this paper is to map ethical concerns arising from the use of social robots in the social professions. The focus will be primarily on application contexts but will include some foundational perspectives to explore relevant ethical nuances and potential gaps within the research reviewed here. For example, the question of whether and to what extent the development of autonomous robots, with capacities for moral decision-making, would be desirable brings up more foundational questions regarding autonomy and agency. Accordingly, some considerations with regard to machine morality will be discussed within the scope of this paper.

Professional ethics in the social professions

The social professions are characterized by close engagement with persons who are in positions that could be characterized as vulnerable or in need of care, either because of the stage of their lives, because of specific health conditions or functional impairments, or because of social marginalization or other specific risk factors. The practice of the social professions includes, for example, the care of children in early childhood settings as well as other supportive and care environments such as education, the long-term care of older persons, the care of persons with disabilities at all life stages, or the support of persons who are identified as disadvantaged or at risk. Practitioners of the social professions may engage with persons in domestic, residential, educational or other institutional settings.

The engagement which is taking place between professionals and vulnerable persons can raise complex ethical challenges. Given the variety of professions and specific professional practices under this umbrella, only a general outline of core professional values for these professions can be provided here. Care serves as a shared, prominent ethical concept for the social professions; the notion of care implies supportive engagement with the needs of others, often vulnerable and dependent others. Care ethics, as originally proposed by Gilligan (1982) and Noddings (1984), and further developed by authors such as Tronto (1993) or Kittay (1999), highlights the importance of an individualized and relational understanding of ethical demands arising in caring relationships. It furthermore acknowledges the importance of general ethical demands regarding the context wherein care is delivered, encompassing notions such as advocacy, respect for autonomy, fostering capabilities, confronting injustice

and preventing exploitation. Care ethics has also found direct reception in the field of robot ethics, for example in Van Wynsberghe's (2014) proposals around care-centered value sensitive design (CCVSD).

While from a theoretical standpoint, care ethics proposes a methodological alternative to universalistic approaches, in practice the core values for caring professionals are, both in theoretical reflection and in the development of professional ethics guidance, frequently captured in the shape of principles. Beauchamp and Childress' (2012) principles of healthcare ethics provide a number of useful umbrella concepts that can serve to capture prominent core concerns in the field of the social professions:

- Non-maleficence (doing no harm), exemplified in adherence to professional best practice standards and organizational procedures, attention to client/patient safety and potential risk factors, and accurate handover and record keeping, where appropriate
- Beneficence (doing good), exemplified in attention to fostering client well-being, supporting the maintenance or development of clients' capabilities, and being attentive to their individualized care needs
- Respect for autonomy, exemplified in respecting clients' wishes, supporting skills of independent living, and respecting confidentiality
- Justice, exemplified in being an advocate for marginalized clients, and preventing and counteracting their discrimination and exploitation
- Integrity, exemplified in a personal and interpersonal experience of authenticity and congruency, and in remaining true to these values even in the face of social or environmental pressures.

A variety of theoretical frameworks can be used to underpin ethical reasoning with these specific notions, foregrounding and emphasizing different theoretical concepts and ethical methodologies. This variety transfers to the robot ethics debate where a wide range of methodological approaches is present in the reviewed literature. However, in this scoping review an attempt will be made to engage primarily with the identification of core concerns with direct impact on social professions or the teaching of such professions, rather than their theoretical underpinnings. In some cases, however, consideration of distinctive theoretical

conceptualizations will be necessary to do justice to concerns whose significance is best captured in direct relation to these theoretical frameworks.

3 Methodology

This scoping review on ethical issues in social robotics was conducted as part of the work of the ERASMUS+ PRoSPERO consortium, in parallel with reviews on S*tatistics and trends in social robotics, Social robotics technology development, Social robotics and related policy development* and *Pedagogy for technological change*. The protocol for this review was developed using the methodological framework proposed by Arksey and O'Malley (2005). The proposal has been reviewed and revised internally within the research team of the PRoSPERO consortium.

3.1 Search strategy and data sources

One researcher conducted a comprehensive literary search on the following nine databases, from project inception until the 29th of November 2018: Psycinfo, Medline, PubMed, CINAHL Academic Search Premiere, Applied Science & Technology Source, Scopus, Proquest Materials Science and Engineering database and ProQuest. Dates were restricted to 2000 or later, with the exception of Applied Science & Technology Source, where the search was restricted to 1990 or later to accommodate earlier standpoints from within the field of STS. No language, geographical or study design restrictions were applied. Search parameters are provided in the table below (Table 1). We also searched Google for information on the conduct of scoping reviews and identification of relevant ethical working groups or guidance documents. In addition, we reference-scanned a relevant systematic review (Vandemeulebroucke, Dierckx de Casterlé, & Gastmans, 2018) and made use of a database of articles and reviews shared through personal communication within the PRoSPERo-group.

Database	Date	Search-		Results
		Group 1: (social) Robotics/autonomous technololgies	Group 2: Ethics	
PSYCINFO	29-11-2018	(AB robot OR TI robot OR MM robotics OR TI "care robot*" OR AB "care robot*" OR AB "service robot*" OR TI "service robot*" OR AB "social robot*" OR TI "social robot*"))	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	168
Academic search premiere	29-11-2018	(AB robot OR TI robot OR MM robotics OR TI "care robot*" OR AB "care robot*" OR AB "service robot*" OR TI "service robot*" OR AB "social robot*" OR TI "social robot*"))	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	309
Applied STS source	29-11-2018	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	178
CINAHL	29-11-2018	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	58
PUBMED	29-11-2018	Robot*[Title/Abstract] OR "robotics*"[MeSH] OR social robot*[Title/Abstract] OR care robot*[Title/Abstract] OR service robot*[Title/Abstract]	"ethics"[Mesh] OR ethic*[Title/Abstract] OR Machine ethics[Title/Abstract] OR ethical issues [MeSH] OR EPSRC [Title/Abstract]	293
MEDLINE	29-11-2018	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	(MW ethic* OR AB ethic* OR TI ethic* OR ((AB Machin* OR TI Machin* OR MW Machin*) AND (AB ethic* OR TI ethic* OR MW ethic*)) OR MM "Ethical issues")	191
PROQUEST	29-11-2018	ab(Robot* OR "robotics*" OR social robot* OR care robot* OR service robot*)	ab("ethics" OR ethic* OR Machine ethics OR ethical issues OR EPSRC)	311
Proquest Materials Science and Engineering database	29-11-2018	ab(Robot* OR "robotics*" OR social robot* OR care robot* OR service robot*)	ab("ethics" OR ethic* OR Machine ethics OR ethical issues OR EPSRC)	281
SCOPUS	29-11-2018	TITLE-ABS-KEY (robot* OR robotics OR "care robot*" OR "service robot*" OR "social robot*")	TITLE-ABS-KEY (ethic* OR 'Machin* ethics*" OR "ethical issues')	164

3.1.2 Eligibility criteria and study selection:

Based on preliminary search parameters, post hoc inclusion and exclusion criteria were generated (Arksey & O'Malley, 2005). The following types of papers were included: 1) All literary reviews (including other scoping reviews and systematic reviews); 2) Research papers including conference papers, journal papers or grey literature; 3) Book chapters and reviews; 4) Policy and guidance documents. The content parameters of the initial search were kept wide to allow for greater inclusion, by including all domains of ethical aspects of social robotics. After removal of duplicates, the initial search gave 782 results.

The selection of articles for the review then went through two selection stages. One researcher reviewed abstracts for relevance based on these criteria. Initially, for round 1 of the selection, the content of abstracts was reviewed to include any articles that substantially addressed ethical concerns in social robotics that appeared relevant for the social professions widely understood, and excluding those that were concerned with robots that had no likely application in the field, such as surgical, industrial or military robots, or those where ethical concerns were not clearly addressed. This first round of selection gave 299 results.

In round 2 of the selection, these results were reviewed for strict relevance on the basis of the full text documents. The criteria for this review were whether the applications discussed had direct relevance for the social professions, whether ethical issues were substantially addressed, and whether an original contribution rather than a mere overview of commonly known themes was provided. Book reviews, brief introductory overview articles and contributions where these issues were only addressed tangentially were thus excluded. Articles with a primary focus on foundational questions in philosophy, such as the status and rights of artificial moral agents (42 items), were excluded as being insufficiently practically relevant despite connecting thematically to some extent. Articles addressing applications adjacent to social care or education, such as hospital care, mainstream education or childcare, were reviewed for practical relevance, and were retained if they shed light on aspects relevant to the ethical social professions. Articles addressing macro-level legal, policy and governance issues that were not clearly relevant for social robotics (25) were also excluded from the main body of the analysis, although some content derived from this literature has been utilized for setting the context. The final selection gave 149 items addressing ethical concerns.

3.1.3 Methodological quality

We did not appraise the quality of the methodology nor risk of bias of the included articles. Also, many of the articles included were conceptual and considerations relevant for the assessment of empirical studies did not apply. This is consistent with accepted practice for scoping reviews (Arksey & O'Malley, 2005).

3.4 Charting the data

After the final set of studies were selected, the authors proceeded to extract relevant information pertaining to the research questions. When scoping the publications with a view to their potential relevance to the field of social professions, several distinct fields of interest emerged:

- Ethical relevance of morphology and materiality of robots (Adams, Encarnação, Rios-Rincón, & Cook, 2018; Coeckelbergh et al., 2016; Pearson & Borenstein, 2013; Peca & Coeckelbergh, Simut, Costescu, Sebastian Pintea, Daniel David, Bram Vanderborght Costescu, Sebastian Pintea, Daniel David, and Bram Vanderborght, 2016; Richardson et al., 2018; Tsun, Theng, Jo, & Hui, 2015; Coeckelbergh, 2009; Damiano & Dumouchel, 2018; Damiano, Dumouchel, & Lehmann, 2015; Fujita, 2001; Ishiguro, 2006, Thomas Arnold & Scheutz, 2017; Pearson & Borenstein, 2014)
- Robots that fulfil care or companionship tasks, both with regard to older persons (Bendel, 2015, Baisch et al., 2018; Bogue, 2013; Coeckelbergh, 2016; Draper & Sorell, 2017; Espingardeiro, 2014a; Frennert & Östlund, 2014; Jenkins & Draper, 2015; Klein & Schlömer, 2018; Lehoux & Grimard, 2018; Locsin, Purnell, Tanioka, & Osaka, 2011, Łukasik, Tobis, Wieczorowska-Tobis, & Suwalska, 2018; Metzler & Barnes, 2014; Metzler, Lewis, & Pope, 2016; Misselhorn, Pompe, & Stapleton, 2013; Pilotto, Boi, & Petermans, 2018; Rigaud et al., 2011; Sharkey & Sharkey, 2011; Sharkey & Sharkey, 2012a; Sharkey & Sharkey, 2012b; Sorell & Draper, 2014; Sparrow & Sparrow, 2006; Tanaka & Ghosh, 2011; Tobis, Salatino, Tapus, Suwalska, & Wieczorowska-Tobis, 2017; Vandemeulebroucke, de Casterlé, et al., 2018; Vandemeulebroucke, Dierckx de Casterlé, et al., 2018; Wu, Fassert, & Rigaud, 2012; Wu et al., 2014) and with regard to children (Belpaeme & Morse, 2010; Castellano & Peters, 2010; Etzioni & Etzioni, 2017; Feil-Seifer & Matarić, 2010; Mercer, 2010; Pearson & Borenstein, 2014; Petters, Waters, &

Schönbrodt, 2010; Ruiz-del-Solar, 2010; Amanda Sharkey & Sharkey, 2011; N. Sharkey & Sharkey, 2010; Tanaka & Kimura, 2010; Torras, 2010; Vallès-Peris, Angulo, & Domènech, 2018).

- Social robots for educational tasks (Génova & González, 2017; Heerink, Vanderborght, Broekens, & Albó-Canals, 2016; Tanaka, 2014, Fridin, 2014), especially in the education of persons with special needs such as autism (Adams et al., 2018; Coeckelbergh et al., 2016; Pearson & Borenstein, 2013; Richardson et al., 2018; Tsun, Theng, Jo, & Hui, 2015).
- Use of sex robots for persons with disabilities or impairments (Döring, 2017; Di Nucci 2016, Wolbring & Yumakulov 2014, Bendel 2015)
- Reflection of relevant ethical considerations for social robotics in regulation and legislation (Fosch-Villaronga & Heldeweg, 2018; Pagallo, 2018; Yueh-Hsuan Weng, 2010) and guidance and policy documents, such as EPSRC's principles of robotics (Boddington, 2017; Müller, 2017a; Szollosy, 2017; Voiculescu, 2017),

In the following, each of these fields will be explored in more detail and elements of practical significance for social care will be highlighted, finally we will point to potential gaps in knowledge and literature, based on the field of research.

4 Ethical relevance of the morphology and materiality of robots

Since the inception of social robotics, substantial attention has been paid to physical features of robots, largely motivated by the interest in ensuring robot accessibility as well as acceptability to the intended users. Physical characteristics of robots influence human attitudes and expectations towards them. The appearance of a robot impacts whether and for how long users are willing to engage with them and whether they find interacting enjoyable (Damiano, Dumouchel, & Lehmann, 2015; Fujita, 2001; Ishiguro, 2006; MacDorman & Ishiguro, 2006). Accordingly, designing aesthetic features of robots has potential ethical implications (Kerruish, 2016; Pearson & Borenstein, 2014).

HRI research has long established that human users have strong tendencies to perceive and react to robots as if they were animate beings, even though they may, at the same time, understand fully that they are merely cleverly programmed technical devices (Fridin, 2014; Turkle 2011). Turkle (2011) therefore describes robots as "relational artefacts" that function as "liminal objects" (see also: Prescott, 2017), to capture the tension implicit in their

seemingly simultaneous perception as animate and inanimate. However, while acceptability increases consistently with greater similarity to humans or animals, if robots begin to resemble human beings too closely, without completely eliciting normative human-like forms of interaction, they begin to be perceived as "uncanny" (Freud, 1919/2003) and in those cases acceptability decreases in most cultures, with the possible exception of some parts of Asia (Mori, 1970; MacDorman & Ishiguro, 2006).

A further point of emphasis is that when robots look like humans (anthropomorphic) or animals (zoomorphic) certain projections occur in the use of, and interaction with the technology (Coeckelbergh, 2009; Damiano & Dumouchel, 2018; Damiano, Dumouchel, & Lehmann, 2015; Fujita, 2001; Ishiguro, 2006). Damiano & Dumouchel (2018) describes this phenomenon as "anthropomorphic projection", and states that such projections can be evoked on the basis of quite different characteristics, from physical-morphological features to functional features:

> *" [It] … can be exemplified with three kinds of robots: (i) robots like Paro1, whose realistic animal-like appearance encourages anthropomorphic projections, in spite of its limited social AI; (ii) robots like Jibo2, whose appearance is not conducive to anthropomorphism, but which nonetheless gives rise to such projections because of its sophisticated social performances; and (iii) robots like Affetto3, whose anthropomorphic appearance is matched by high level social AI"* (Damiano and Paul, 2018: 3).

The expectations associated with these projections include the assumption of qualities, processes of thought, and general capabilities of robots (Coeckelbergh, 2009; Damiano & Dumouchel, 2018; Fridin, 2014; Fujita, 2001; Ishiguro, 2006; Oriel, 2014). HRI research has shown these projections to be extremely common, as reported by Turkle (2011). The more autonomous the robot is in interaction, the more likely is the ascription of higher abilities and the definition of the relationship as different from one to other objects and therefore more ethically significant (de Graaf, 2016). In cases involving children, research shows that the robot will consistently be attributed substantively human characteristics such as emotions, free will, preferences and male gender (Bumby & Dautenhahn, 1999; Tung, 2016). Especially emotional features have been shown to impact on how a robot is perceived; this raises the question whether and under which circumstances it is ethical to design for emotionality in

robots (Nitsch & Popp, 2014; Novikova & Watts, 2015; Vallverdú & Casacuberta, 2015). Affect-aware social robots may also bring in additional challenges such as privacy and manipulation of users which need to be addressed in the design process (Wilson, Scheutz, & Briggs, 2016). One might ascribe such combinations of physical and emotional characteristics, expectations, projections and general capabilities of and towards robots to entanglements of human-robot materiality (Barad, 2007; Harraway, 1997; Butler, 2011; Søndergaard, 2019) thus acknowledging and ascribing agency to both robot- and human materiality. *"(…) matter itself entails entanglements – that this is its very nature. By 'entanglement' I don't mean just any old kind of connection, interweaving, or enmeshment in a complicated situation."* (Barad, 2007: 160). Rather, entanglements provide a theoretical framework concerning concepts of care, compassion and empathy, Søndergaard argues (2019), through which researchers can understand the interconnections between in Søndergaard's case technology-entangling-human enactment, in this instance, a robot and human materiality conversely. Such entanglements also include concepts of causality, materiality and agency in the interconnectedness of subjects as well as objects in the world (Barad, 2007) and should furthermore be a part of the ethical considerations (Søndergaard, 2019).

More closely related to practice, Fridin argues *"(…) that children and adults can and often do establish meaningful and robust social conceptualizations and relationships with a robot that they recognize as a technology"* (Fridin, 2014: 263). Projections or mediation of certain human materiality towards physical objects such as robots, become potentially more ethically complex in cases where the users are children (Fridin, 2014), or lack full capacity such as persons with dementia (Sharkey & Sharkey 2012, Sharkey & Sharkey 2010), raising the ethical issue of deception (see also Matthias, 2015). In such cases, users may genuinely misunderstand the nature of the robot and attribute capacities for mutuality and care to them that the robots do not have (e.g. taking Paro to be a pet that develops a mutual relationship with them, treating robotic dolls as "babies", and engaging with robots on the assumption of mutual care and affection). Coeckelbergh argues, however, that it may be inappropriate to understand these phenomena as "deception", as the semantics of such a concept would lead to distinctions of real vs not-real, when ethical analysis on whether the performance, understood as a relational process, is good or not, are simply more contextually relevant (2018).

A similar point is made by Gunkel (2015) who considers whether we should respond to robots more as objects or as entities that users would be justified in genuinely caring about. Intercultural research indicates that there might be cultural differences in how these relationships are conceptualized (H. R. Lee, J. Sung, S. Šabanović, & J. Han, 2012). Metzler & Barnes argue that engagement with robots might have a significant impact on how we understand ourselves (2014). The materiality of both humans and robots then becomes mutually entangled in their agency. Robust and meaningful relationships to robots that are established through such an aforementioned anthropomorphic production of human potentiality and materiality (Coeckelbergh, 2009) call for a more wide-ranging ethical analysis wherein materiality, agency and expectation are analyzed alongside the issue of the potential deception of users regarding the nature of robots (Sharkey & Sharkey 2012). Within some of the aforementioned perspectives the robot thus becomes both what they are to the user, and what they are as a physical material being (or what they are not/cannot do), the two not necessarily conjoined but at least entangled, calling for research methodology wherein such ethical complexities are accounted for (Harraway, 2016; Hasse & Blond, 2017; Chimirri et al, 2018).

A future point of departure then becomes not limiting perspectives on agency to solely intentionality of production or complete human agency and disregarding the multifaceted materiality of the technology because of care, empathy or compassion from the researcher. Such a limitation, within research involving technology, would risk: "(…) *analytically devitalizing parts of the more comprehensive apparatus that (co-)produces the risks and dysfunctions in focus"* (Søndergaard, 2019, pp. 5). This is a point of emphasis later in this review in relation to sex robots, where perspectives based on user experience are ignored or not sought due to fundamental objections to even contemplating sex with robots (Döring, 2017). This refusal to engage with the issue on an experiential basis, based on its controversial nature, potentially limits our understanding of an area where the materiality and human-robot relationships could be particularly relevant.

The functionality of the social robots in and of themselves seems to also produce a materiality mediated within the human-robot interaction: *"Some soldiers have emotionally bonded with the bomb-disposing PackBots that have saved their lives, sobbing when the robot meets its end"* (Lin, et. al. 2010: 947). Furthermore, users' attachment to robots in general may potentially become ethically problematic (Fridin, 2014; Huber, Weiss, & Rauhala, 2016),

especially if robots are withdrawn from users after a trial period (Beyan, Felzmann et al. 2015). An ethical framework would then need to entail and accept the produced materiality of robots in their intra-agency with a human counterpart, as well as the potential emotional consequences for said human (in a neo-technophilosophical perspective, potentially the robots as well). Such an ethical framework, as Lin et. al. points to in 2010, is still underrepresented in the literature and it is furthermore unclear whether replacing a human relationship with that of a robot, can cause psychological harm to the end user, when such a robot is ascribed a certain agency.

5 Robots that fulfil care or companionship tasks

Care-related functions are one of the core features of current social robots, even though their practical effectiveness is still limited (Buhtz et al., 2018) and their embeddedness in real life care settings encounters challenges (Cresswell, Cunningham-Burley, & Sheikh, 2018). More interdisciplinary and socially sensitive research is needed to allow a good understanding of public and user attitudes and the reality of robots in the lifeworld, a necessity for a well-grounded assessment of these technologies as well as adequate ethical assessment (Decker, 2012; Decker et al., 2011; Decker, 2008; Del Casino, 2016; Enz, Diruf, Spielhagen, Zoll, & Vargas, 2011; Espingardeiro, 2014a; Feil-Seifer, Skinner, & Matarić, 2007; Laryionava & Gross, 2012; Lehoux & Grimard, 2018; Ljungblad, Nylander, & Nørgaard, 2011; Moon, Danielson, & Loos, 2012; Pilotto et al., 2018; Rantanen, Lehto, Vuorinen, & Coco, 2018; van der Plas, Smits, & Wehrmann, 2010; van Kemenade, Hoorn, & Konijn, 2018; Wu et al., 2014). It has been pointed out that there is a need for seeking out the perspectives of users, especially to prevent negatively stereotyped representation of users (Frennert & Östlund, 2014). Robot assisted care of vulnerable persons is associated with significant ethical concerns, but also opens up new possibilities of realizing care (Coeckelbergh, 2015; Aimee van Wynsberghe, 2013). Discussions of ethical concerns relating to the use of social robots are particularly prominent with regard to specific vulnerable groups of care recipients:

(i) robot assistance of older persons, especially those who suffer from dementia or are otherwise frail

(ii) robot care and entertainment of children in various care settings

Most discussions on ethical issues with care robots relate to the care and assistance of older persons, especially the care of persons with dementia (Baisch et al., 2018; Bogue, 2013; Coeckelbergh, 2016; Draper & Sorell, 2017a; Espingardeiro, 2014a; Frennert & Östlund, 2014; Ienca et al., 2017; Ienca, Jotterand, Vică, & Elger, 2016; Jenkins & Draper, 2015; Klein & Schlömer, 2018; Lehoux & Grimard, 2018; Łukasik et al., 2018; Metzler & Barnes, 2014; Misselhorn et al., 2013; Pilotto et al., 2018; Rigaud et al., 2011; Sharkey & Sharkey, 2011; Sharkey & Sharkey, 2012; Sharkey & Sharkey, 2012; Sorell & Draper, 2014a; Sparrow & Sparrow, 2006; 'The Swedish National Council on Medical Ethics (SMER, Sweden), 2017; Tobis et al., 2017; Vandemeulebroucke, de Casterlé, et al., 2018; Vandemeulebroucke, Dierckx de Casterlé, et al., 2018; Wu et al., 2012, 2014). Motivating factors underlying this prominence of social robot applications for the care of older persons are especially demographic developments towards an increasing number of old and very old persons in the population of developed countries (WHO, 2015) and the dramatic projected shortages of carers that will be available for the care of these older persons (Matarić, 2006). Social robots are seen as a potential solution to this coming issue, and substantial resources are being put towards the development of care robots, for instance by the European Commission.

A second much discussed area of ethical concern is the use of robots to provide care or entertainment for children, much of it related to a primary contribution by Sharkey & Sharkey in 2010 on "robot nannies" (Belpaeme & Morse, 2010; Castellano & Peters, 2010; Etzioni & Etzioni, 2017; Feil-Seifer & Matarić, 2010; Mercer, 2010; Pearson & Borenstein, 2014; Petters et al., 2010; Ruiz-del-Solar, 2010; Sharkey & Sharkey, 2011; Sharkey & Sharkey, 2010; Tanaka & Kimura, 2010; Torras, 2010; Vallès-Peris et al., 2018). Robotic applications for children are researched extensively in HRI, and social robots for children with entertainment functions are widely available commercially as toys. Turkle (2011) raises some ethical concerns regarding the risks of the emotional draw of such robots as pleasing relational artefacts at the expense of real-life interactions for children and adults alike, but these concerns were not widely represented in the literature reviewed and there was only limited evidence of their discussion from an ethical perspective. The development specifically of care, rather than educational, applications for children appears less developed than for older persons and their discussion is mostly restricted to the discussion of the hypothetical

scenarios presented in Sharkey & Sharkey (2010). Petters et al. (2010) raise concerns with regard to attachment to robots in light of psychological attachment theory. Castellano & Peters (2010) emphasize the issue of manipulation of children by robotic care systems on the basis of the potential for sophisticated recognition of emotional clues. One particular concern in this context is the elicitation of false beliefs to increase bonding in children. Ethically, this also raises the question of deception of vulnerable persons. At the same time, as Belpaeme & Morse (2010) highlight, pretend play is a dominant feature of young childhood and therefore the treatment of robots as full interaction partners at that age might not be considered unusual or worrying. One of the core ethical concerns in this application area mirrors concerns also found in the elderly care domain, namely the replacement of humans by robots. Etzioni & Etzioni (2010) mirror concerns expressed by van Wynsberghe (2011, 2014) among others that the appropriate use of robots should be as "partners" in care, working alongside humans and enhancing human care, rather than as replacements of carers. Feil-Seifer and Mataric (2010) contend that first of all, in most current robotic research in the field robots are designed as adjunct to human carers to be used jointly, not as replacement. This is also echoed by other authors such as Baisch et al. (2018) and Pearson & Borenstein (2013). Palm, Nordgren, Verweij, & Collste (2013) argue that rather than applying a simple replacement paradigm, the nature of care is likely to change in complex and unpredictable ways in response to the use of care robots. However, others argue that a comparatively high degree of robot autonomy may nevertheless be important to achieve viable use of robots in the pursuit of caring goals (Esteban et al., 2018). Secondly, they argue that the risk of withdrawal of attention from children when technology is employed in their care is a more general concern that is not specific to robots alone. Ruiz del Solar (2010), who takes Sharkey & Sharkey's (2010) concerns to be significant, emphasizes the need to develop both a better evidence base and to begin the development of relevant regulations. One interesting approach in robotics for children that engages practices of care is the use of the "mutual care" paradigm, i.e. robots designed to engage children in caring activities towards robots. However, these are usually conceived primarily for purposes of education or entertainment, rather than specific care functions (Tanaka & Ghosh, 2011; Tanaka & Kimura, 2010).

Within these care domains, functionalities of social robots include, for example, companionship, cognitive support, cognitive activation, physical activation and exercise, and social inclusion (via telepresence). From an ethical point of view, it may be helpful to classify these functions according to their ethically relevant goals, as they come with different ethical potential and risks:

1. Protection from harm
    a. of user: safety and risk monitoring, reminders
    b. of others: parenting skills monitoring (e.g. robot baby)
2. Increasing well-being and supporting daily living
    a. physical: exercise, hygiene, compensation of impairments
    b. cognitive: support, compensation of deficits
    c. social: social connectedness, affection, remembrance
    d. support of carers
3. Enhancement of independence

While these three general categories of functions are in keeping with established core principles of healthcare ethics, they may nevertheless conflict with each other in certain circumstances. For instance, protective and monitoring functions may be realized in a manner that is intrusive and unduly paternalistic.

5.1 Protection from harm

Robots have to be safe and not cause harm to humans during their use; this is regulated through safety standards (Hasebe, Kawamoto, Kamibayashi, & Matsushita, 2014). The risk of overtrust in automated systems is a significant challenge (Wagner, Borenstein, & Howard, 2018). They also should not discriminate, a problem that has only recently been recognized more widely as a serious issue for information technologies such as the U.S. justice system's usage of AI technologies that discriminates against racial minorities (Howard & Borenstein, 2018). However, protection from harm refers to the purpose of actively using robots to prevent certain types of harm for users. Assistive technologies, especially for older persons, often include functions that are meant to reduce risk and protect vulnerable users from harm. Frequently, this includes monitoring and surveillance, as well as the provision of reminders based on results from monitoring. In childcare, the use of child monitors is extremely common. For persons

with dementia who are at risk of wandering, GPS trackers are a technology that is popular with carers (Meiland, et. al. 2017). For persons with complex medical needs, adherence to medication regimes is another concern that has been addressed for instance through the development of smart medical containers which send signals when opened, or even pills which send signals when digested (Chen, Kehtarnavaz, & Jafari, 2014). Smart homes for ambient assisted living generally include various monitoring functions (Rashidi, & Mihailidis, 2012). It is unsurprising that the potential of robots to fulfil medication taking support and monitoring functions has also been explored and is being positively endorsed, especially by carers (Alaiad & Zhou, 2014). One particular advantage of robots vis-à-vis other assistive technologies, is that they operate in the physical world with some degree of autonomy. Robots could be designed to track the movement of persons and follow them and may use reminders for the person themselves or alerts to a third party, thereby facilitating the prevention or speedy identification of risky behavior such as wandering, risky medication practices, low intake of food or drink (Łukasik et al., 2018), leaving kitchen appliances switched on unsupervised, problematic hygiene, or weather-inappropriate clothing (Beyan, et. al. 2015). Telepresence functionalities of mobile robots, such as the GiraffPlus, may serve such monitoring functions, but may also be used for social functions discussed further below (Jenkins & Draper, 2015; Sorell & Draper, 2014a). One particular challenge with monitoring functions is the invasion of the user's privacy and potential challenges with regard to data uses (Körtner, 2016; Schafer & Edwards, 2017; Sedenberg, Chuang, & Mulligan, 2016; Sharkey & Sharkey, 2012; Beyan, et. al. 2015).

Robots can also be used to monitor the user's ability to care for others. For instance, robot babies are being used by social services with parents who might be considered at risk to monitor the performance of basic parenting skills as practiced with the robot (Søgaard, 2019). The idea underlying this particular use of monitoring robots is that early identification might prevent parenting practices that might put a child at risk (see also further discussion of this case under educational functions of those robots).

5.2 Increasing well-being

One core characteristic of effective caring is that the needs of the persons receiving care are being met, thereby contributing to their well-being (Ienca et al., 2017). Social robots can contribute to well-being with regard to a number of different domains, such as

physical wellbeing, cognitive wellbeing, or social wellbeing. However, more research and user engagement is needed to inform the design so it genuinely meets user-needs (Ienca et al., 2016). It also needs to be explored whether robot use carries social stigma, and how such stigma might be addressed (Blackman, 2013, Søgaard,2019).

With regard to physical wellbeing, robots can provide support in activities of daily living (Bedaf, Gelderblom, & de Witte, 2015), such as hygiene or food intake. They may support either the care receivers themselves or the care providers, for example to lift or bathe the person in need of care (van Wynsberghe, 2013). However, the specifically social functions of robots in this particular field are currently limited, and in the ethical literature reviewed there was only a limited amount of discussion of these functions, with the exception of Van Wynsberghe (2013) and Klein & Schlömer (2018). An additional application would be robots designed to activate persons to engage in physical activity which is closely linked to increased wellbeing in various domains, for example through encouragement to engage individuals in certain activities or more indirectly to offer music suitable for dancing or singing along. For frail persons, social robots may also compensate for physical impairments and provide services such as fetching items or tidying specific items into designated spaces (Casey et. al., 2016).

Areas that are particularly frequently discussed in the literature include the opportunities and pitfalls arising from the use of robots for social functions, including some advanced social functions such as elements of psychiatric counselling (Bickmore & Gruber, 2010). One of the most fundamental concerns has been that robots may replace relationships to real human beings, and that sociality involving a robot is not genuine sociality (Sharkey & Sharkey, 2012; Sparrow & Sparrow, 2006). It is debatable whether the affective bond with a robot could be an element of a flourishing life (de Graaf, 2016), or whether it is a potentially significant liability if attachment develops (Huber et al., 2016). On the other hand, robots may also serve social connectedness, especially in domestic settings, by means of telepresence functions through directly connecting robot user with family members who may not otherwise be present in their lives, or with professional carers (Draper & Sorell, 2017a; Casey, et. al. , 2016; Jenkins & Draper, 2015; Beyan, et. al. 2015). Entertainment and cognitive functionalities may also have a social function. Robots who deliver information or provide enjoyable activities for persons who are non-mobile may also signify participation in the outside

world for those users. For example, mobile telepresence robots that can be used by persons with mobility issues to participate remotely in cultural offerings, as used by some museums, fulfil such function. Robots who provide reminiscence functions provide users stimuli that may help to re-connect them with the trajectory of their lives or communities.

With regard to social functionalities, it has also been discussed whether the design of actively non-compliant robots might be a good idea (Billard, 2017), specifically also whether it would be ethically appropriate to design robots in a way that incentivizes users to be polite (Jenkins & Draper 2014), and whether robots should be developed to nudge their users into becoming more empathetic (Jason Borenstein & Arkin, 2016, 2017).

The use of robotic animals or dolls, such as Paro or other robotic animals, has been extensively researched, with varying user responses (Moyle et al., 2015, 2017). Robotic animals can be seen to fulfil proto-social functions by increasing comfort and engagement in basic or even more complex forms of social responses with those robotic animals. This shows calming effects, and may help persons with dementia to engage better with other human beings around their robot use (Chiberska, 2018). However, as indicated above, it has been argued that such use of robotic animals may constitute deception or infantilization for those who do not have the capacity to understand the nature of robotic animals and therefore are problematic (Sharkey & Sharkey, 2012; Sharkey & Sharkey, 2012). The particular ethical status of the affective responses in relationships to robotic pets has been explored (Rodogno, 2016). Technology, such as Smart Homes, might also be employed to facilitate the keeping of real pets as an option (Preuß & Legal, 2017). With regard to Paro, Misselhorn et al. (2013) argue that a careful context-dependent analysis of such uses of robot animals is needed, rather than sweeping generalizations.

A distinct ethical concern with regard to care and wellbeing is the support of caregivers who may be at risk of physical injury, mental health impacts or burnout in challenging care situations. The use of healthcare robots to supplement human care promises to alleviate both physical and psychological burdens of care (Huschilt & Clune, 2012). Social robots have particular potential to address psychological burdens arising from engagement with challenging behavior or at times draining modes of interpersonal

interaction by some persons with dementia. At the same time, it has been argued that engagement with carers and caring professionals is needed, including reflection on future training for robot use by professionals (Sharts-Hopko, 2014).

However, there could be discrepancies between support needs by care receivers and care providers; this tension is acknowledged in Borenstein and Pearson's work (2010; 2013). It has been argued that using ethically designed robots might facilitate constructive improvements for both caregivers and care recipients (Borenstein & Pearson, 2010; Parks, 2010; Pearson & Borenstein, 2013; Santoni de Sio & van Wynsberghe, 2016; van Wynsberghe, 2013; Wynsberghe, 2016). In contrast, some authors highlight the risk that robots may undermine social caring relationships (Parks, 2010), or allow carers to escape uncomfortable realities of care, including the uncomfortable realization of human life as beset by vulnerability, dependency and ultimately decline, thereby disincentivizing them from taking on the caring role and ultimately stunting moral development, with potentially wider social consequences (O'Brolcháin, 2017; Vallor, 2011).

5.3 Enhancement of independence

In the literature on care robots, especially robots for older persons, their role in supporting independence is a prominent theme. For some persons with more severe impairments, autonomy, transparency and independence may not be appropriate goals for the use of care robotics (Coeckelbergh, 2016) but many care robots are being designed for persons with less impairments, especially for domestic settings, with the explicit purpose of allowing frail persons or person with mild dementia to live independently in their homes for longer (Huschilt & Clune, 2012; Tobis et al., 2017). The previously discussed functions of harm prevention and wellbeing improvement are meant to facilitate such independence by reducing risks that might otherwise lead to the initiation of institutional care and allowing persons a healthier everyday life, which also contribute to increased ability to manage their lives. Parks (2015) argues that robots which facilitate persons to stay in their homes for longer should be seen as extending their capacities in ethically valuable ways by allowing them to preserve their identities.

The aspect of facilitating, but also partly limiting, the user's autonomy and control is prominently discussed in (Borenstein & Pearson, 2010; Draper & Sorell, 2017b; Sharkey

& Sharkey, 2012; Sorell & Draper, 2017; Sorell & Draper, 2014b). One concern is that in the service of independence, it might appear desirable to design paternalistic functions in robots, to allow persons to stay safe, and keep up their health or skills. Jenkins & Draper (2015) and Sorell & Draper (2014b) argue whether it is appropriate to have paternalistic robot functions in order to maintain the skills and bodily condition needed to remain independent, or whether users should be allowed the freedom to engage in risky behavior.

6 Robots for learning, skills development and rehabilitation

Ethical issues in the use of robots for educational purposes arise both in the context of mainstream classrooms (Fridin, 2014; Serholt et al., 2017; Tanaka, 2014; Tanaka & Kimura, 2010) and in the context of learning for children and adults with impairments, such as in the area of rehabilitation (Iosa, Morone, Cherubini, & Paolucci, 2016; Voelker, 2005). With regard to the application to social care contexts, the area of social robotics that is most prominently discussed in the literature is educational work with children with disabilities, especially autism (Adams et al., 2018; Coeckelbergh et al., 2016; Pearson & Borenstein, 2013; Peca , et. al. 2016; Richardson et al., 2018; Tsun et al., 2015). This comprises subject matter teaching (such as teaching colors, letters, or body parts), play (such as dancing, imitation, reacting to musical stimuli), facilitating the expansion of manipulation of objects for physically disabled children (Adams et al., 2018) or social skills learning (e.g. reading expressions, practicing verbal exchanges). For such highly vulnerable groups, similar ethical challenges arise in the educational setting as were identified with regard to the care setting, concerning deception, marginalization and replacement of human care by robots. Coeckelbergh et al., 2016; Peca et al., 2016; Richardson et al., 2018) studied empirically and with a large international sample of various stakeholders, the ethical acceptability of robot assisted interventions for children with ASD. In their analysis, they emphasized that while respondents were in favor of robots as assistants, they were not in favor of replacement of human therapists (Peca et al., 2016). Similar to the discussions with regard to the care sectors, they highlighted the importance of ensuring trustworthiness of robot assisted interventions by ensuring human supervision at all times and limiting the degree of autonomous operation of the robot in direct contact with the child. In order

to assess these concerns, more empirical studies are needed regarding how such robots are being perceived, especially in relation to longer term uses.

One further concern was to ensure that the robot was carefully designed to the level of ability and the interests of the user so that the robot is beneficial for the users, with regard to achieving a meaningful expansion of their abilities (Adams et al., 2018; Pearson & Borenstein, 2013). Pearson and Borenstein (2013) draw on Nussbaum and Sen's ethical capabilities approach to underpin these considerations. The capabilities approach identifies a variety of components of a flourishing life and has been used widely across different sectors as ethical underpinning for human rights. It was originally developed in the context of rights for citizens of developing countries but is now drawn on in many other sectors, including the area of disability rights. Capabilities are further discussed in the PRoSPERo scoping review on policy and regulation of robotics (Share & Pender, 2019).

The use of social robots for skills development and rehabilitation is not restricted to uses involving children with autism or developmental disability. They can be used in mainstream educational settings, to foster social skills and play (Fridin, 2014). As described above, socially assistive robots for persons with dementia have been designed to include the elicitation of cognitive and physical activity. Social robots may also present or support physical exercise regimes for persons with physical disabilities or after stroke; however, robots with these functionalities were not frequently mentioned in the ethical literature surveyed (Tsun et al., 2015). A potential application of social robots for substance abuse rehabilitation, drawing on functionalities for social robots for older persons (such as reminders and safety warnings) was also mentioned in the literature surveyed, albeit only in a hypothetical manner, (Filimon, 2018); other mental health applications were also discussed (Riek, 2016).

A further application specific to the social care field is the use of a robot baby to increase the knowledge of care requirements for babies, support the development of baby care skills among at risk prospective parents, but also monitor and quantify their performance (Søgaard, 2019). This particular application includes a mix of knowledge and skills development and monitoring/surveillance; a substantive ethical difference to the other applications in this section is that its potential use by government agencies

tasked with child protection decisions, introduces a potentially punitive element that is currently absent in the other applications.

According to the literature reviewed here, the primary ethical concerns for these applications of social robots are very similar to those in the category of robots for care. They consist in (i) ensuring that sufficient benefits accrue from the use of robots, with a particular focus on expanding capabilities that correspond to the educational and skills aspect of this application domain, and (ii) the risk of inappropriate replacement of human intervention by robots, with the resulting risk of marginalization of vulnerable persons. More empirical studies conducted with a view to assessing benefit in light of the overall spectrum of ethical risks is however needed. In light of the risk of replacement of human care for clients who are already socially marginalized due to illness or disability, it is ethically essential to review the use of robots in the skills training and rehabilitation domain with a view to whether they constitute a constructive adaptation to the needs of the target group, or whether they further disempower them. It is crucial that attention be paid to the risk of extending wider social neglect and "othering" by means of robot use. With regard to the robot baby and without neglecting the ethical potential of ensuring the reduction of harm to potential future, human babies, it could be argued that its use might further alienate and disempower marginalized at-risk parents who may find their ability to parent subjected to judgments derived from robot measurements. Their care for the object of the robot baby in public might also be subject to normative social regulations, resulting in them not caring sufficiently for the baby in social contexts outside of the home, thus exposing themselves to the collection of negative data by the robot. Regarding the use of robots for persons with autism, who characteristically have difficulties engaging in complex human interactions, there is the risk that they might be assumed, qua the social aspects of their condition, to always prefer engagement with machines to human beings. Extensive use of robots for this target group may therefore not be subject to sufficient critical questioning. Share and Pender's scoping review on policy and regulation of social robotics (2019) explores further the potential roles of regulation of social robotics to address challenges such as these.

7 Robots that fulfill sexual functions

The importance of sexuality as part of human experience raises challenges for the area of social care, especially regarding persons with limited capacities. According to the capabilities approach (Nussbaum 2003), sexuality is included among the first essential human capabilities meriting attention. While statements of universal basic needs, such as Nussbaum's, may be controversial, the general exclusion of persons with disabilities or those living in residential care institutions from sexual experience merits ethical attention. Tepper (2000) highlights this as an issue in what he calls the "missing discourse of pleasure" in the area of disability. It has been pointed out that sex robots might be able to fill such a gap. However, while there is a large body of literature engaging with ethical concerns regarding sex robots in general, the literature reviewed did not include much sustained reflection on this issue, beyond brief mentions of the potential therapeutic benefits of facilitating access to sex robots for persons with disabilities. Brief mentions were included for instance in Wolbring & Yumakulov (2014), Bendel (2015) and Döring (2017). De Nucci (2016) engages more in depth with the question of the use of sex robots in healthcare settings. Empirical studies on public attitudes or potential user perspectives on the use of sex robots are limited so far (Scheutz & Arnold, 2016).

One significant ethical concern is the issue of impaired capacities for persons with intellectual disabilities, dementia or other cognitive or mental impairments. While there is extensive literature engaging with the importance of sexuality for older persons, the issue of sexuality in dementia is often a highly emotive topic (Ehrenfeld, Bronner, et al. 1999). The potential use of sex robots is not specifically explored for this population in the literature so far but is likely to play a role in the future.

A further area of concern that has been controversially discussed is the use of sex robots as a therapeutic tool for persons with paraphilia, such a pedophilia (Behrendt, M., 2017). It has been argued that the use of sex robots could potentially be therapeutic by allowing affected persons to realize their sexual desires without causing harm to others. However, this position is widely rejected, and there have been calls for criminalizing child-like sex robots.

A concern that is repeated regularly throughout the ethical literature on social robots is the fear that increased robot use might lead to a reduction in opportunities for human

contact, specifically as human interactions are replaced by interactions with robots (Coeckelbergh, 2015; Sharkey & Sharkey 2012). As van Wynsberghe (2013, 2016) has argued, the application of care-centred value sensitive design might be a solution to this problem. She proposes to include care related values as essential in the design of technologies to ensure that robotic technology will be employed in a manner that does not stand in the way of ethically valuable care delivery but might contribute to its realization. In a similar vein, Draper & Sorell (2017) propose the inclusion of ethical values in the development of robot technologies (Draper & Sorell, 2017a),

8 Regulation, legislation, guidance and policy

The use of robots in social settings raises potential concerns regarding the identification of and compliance with legal and regulatory requirements. This has particular urgency in cases with heightened vulnerability levels of social care clients. Despite an understanding of the need for guidance and various European initiatives to progress specifically the area of robot law (Pagallo 2018), as of yet, there is no comprehensive and fully developed legal or regulatory approach to dealing with robots in social care settings in the European context, although suggestions have been made towards a comprehensive adaptive approach that allows for the application of an evolving framework in the context of rapid technical development (Fosch-Villaronga & Heldeweg 2018, Fosch-Villaronga 2016). At the same time a number of legal and regulatory instruments as well as industry standards are available that have some relevance for the use of robots in social professions, including the data protection regulation, health and safety legislation, the machine directive, the medical device directive, ISO Standards for healthcare and personal care robots, and even an industry standard on robot ethics by the British Standards authority (Fosch-Villaronga 2016). Accordingly, when the introduction of robots is considered in an institutional or domestic setting, care needs to be taken that legal and regulatory perspectives are being considered. Training regarding potential Health and Safety impacts of robot use and the management of client, professional and bystander privacy from the point of view of data protection requirements are particularly relevant (Schafer & Edwards, 2017).

In some contributions to the question of governance of robotics, ethical concepts and approaches are explicitly linked to concepts of governance (Cath, 2018; O'Sullivan et al., 2018; Pagallo, 2018; Yueh-Hsuan Weng, 2010). Governance and legislation regarding social robots

are often based on various guidelines and policy papers developed either specifically for the field of robotics, or with close relevance to the field of robotics (such as guidance on AI) (EPSRC 2010, EGE 2018, IEEE 2018, HLEG 2019). These groups are working from different backgrounds and with different goals: The EPSRC is a national body for research in engineering with strong industry representation; the IEEE represents international voices of engineers involved in the development of information technologies, equally with strong industry orientation; the EGE membership is appointed by the European Commission from across Europe to advise on general emerging ethical concerns of relevance for Europe; and the HLEG consists largely of established European academics and was specifically appointed for the purpose of developing guidance on emerging challenges in AI. The EPSRC proposes five principles to guide the development of robots in society. The IEEE provides guidance on ethically aligned design. The EGE outlines general challenges with regard to AI. The HLEG opinion is centered on conditions for the achievement of trustworthiness in AI.

The EPSRC's principles of robotics, as an example that has received attention in the literature surveyed, represent an interdisciplinary take on robot- and techno-ethics driven by the industry sector. The aim of the EPSRC was to create principles pertaining to those who design, sell and use robots (Bolden, 2011). According to the council, *"The five ethical rules for robotics are intended as a living document. They are not intended as hard-and-fast laws, but rather to inform debate and for future reference"* (Bolden, 2011). These principles have received critical scrutiny, with several articles identified in the scoping review aiming to improve, criticize or transcend the principles, including their underpinning anthropological assumptions and ethnocentricity (Boddington, 2017; Gning, Davis, Cheng, & Robinson, 2017; Szollosy, 2017; Voiculescu, 2017). Regarding ethnocentricity, several authors point to cultural differences in the perception of the relation of persons and robots (H. R. Lee, J. Sung, S. Šabanović, & J. Han, 2012; Metzler & Lewis, 2008; Szollosy, 2017). In contrast to the high-level guidance documents, in academic documents the point of departure is not the consensus within a group of expert practitioners, but the analysis of challenges of the field through engagement with specific ethical paradigms, from classical perspectives to postmodern or other contemporary perspectives, with self-applied labels such as roboethics, cyberethics, or technoethics (Jason Borenstein, 2012; Espingardeiro, 2014b; Hin-Yan & Zawieska, 2017; Howard & Borenstein, 2018; Vanderelst & Winfield, 2017; Winfield, 2011). This then points to a need for mediation between the more practice-oriented research on ethics within the

field, and the more normative creation of policies and guidelines for both production and usage of technologies within such a field.

9 Conclusion

In this review, we have presented an outline of ethical issues with regard to the use of social robots as pertaining to the social professions. Methodologically, a wide range of ethical approaches and conceptualizations were evident in the literature, including principle-based, virtue ethical, phenomenological, post-phenomenological, relational, and feminist approaches. This methodological richness allowed us to capture a variety of different ethical concerns. While the aim of this review was to remain largely theoretically neutral in reviewing the ethical debate within the field, the value of the different sensibilities arising from different theoretical framework is evident in the richness of concerns identified.

Social robots operate within human-robot relationships, and the ethical characteristics and significance of such relationships were prominently discussed in the literature reviewed. The ethical significance of morphological and affective factors and their impact on the human-robot relationship were explored in depth from a range of philosophical perspectives.

Evident in the literature was that social robots are being developed or could be developed for a wide range of practice contexts in the social professions. However, there were significant differences with regard to the extent of ethical literature addressing each of these domains. The most prominent domain represented in the ethical literature was the performance of care and companionship functions, especially for vulnerable groups, such as older persons, persons with dementia, children, or persons with disabilities. Dementia care robots were one of the more prominently discussed types of care robots in the ethical literature reviewed here. All other groups were significantly less represented, although educational/therapeutic robots for autism and childcare also received some sustained attention. Educational social robots, albeit a highly researched area, appeared to give rise to somewhat less ethical debate. The area of sex robotics for therapeutic purposes was one of the least explored, despite a lively existing ethical debate on sex robotics in general. This under-exploration corresponds to the neglect of consideration of sexuality as a concern in social care contexts more generally. Ethical themes identified included: Critical reflections on the nature of the relationship between humans and robots, the issue of replacement or supplementation of human care by

robots, the ethical use of robotic companions and robotic pets for certain user groups, the question of which circumstances would mandate the deception of the user becoming an ethical issue and the potential tensions between privacy and independence vs harm prevention, improvement of well-being and autonomy. The potential role of robots to contribute to or impair the achievement of a good life was also discussed in several contributions, both with regard to primary users and carers or family members.

While many empirical studies involving users, other stakeholders or the general public were included in the review, a number of contributions highlighted that more research was needed. It was highlighted by many that ethical considerations had to be supported by relevant evidence, and that insights gained should be deeply integrated into the design process. One repeated observation was that the research paradigms used for such research needed to show more awareness of the complexity of social phenomena and more adjustment to real life application contexts. In particular, what was evident from the literature was a comparatively narrow focus on the end-user and considerable less focus on other stakeholders in the care systems whose role will nevertheless be fundamentally affected once robots enter their field of practice. Specifically, consequences to the professional identity of carers or other social professionals received very little focus within the literature.

The review of legal and regulatory concerns showed an emerging body of literature where there is a need for greater clarity and calls for a more coherent and less fragmented approach to regulation and guidance abound. Robotics and AI have been receiving increasing attention by lawmakers recently, which may lead to the achievement of some greater clarity in the nearer future. However, the currently available guidance documents tend to be general and vague and while they address important ethical concerns, they do not provide sufficient guidance to professionals.

In conclusion, we have presented an outline of ethical issues with regard to the use of social robots as pertaining to the social professions, highlighting core themes as well as gaps in the debate. The relational role of robots is a core ethical theme underlying much of the debate and it continues to attract deserved attention. In general, more research involving stakeholders and real-life settings is required, and the role of the professionals vis-à-vis robots needs to be explored more. Further ethical research on specific topics is needed especially with regard to marginalized groups other than persons with dementia or autism, for example

at-risk parents, or persons with disabilities and dementia with regard to the seemingly still taboo topic of the use of sex robots by such a user base.

From the perspective of the social professions, the complexity of ethical issues when using robots in their practice domains is substantial. Therefore, the potential impact of social robotics on the professional roles and identities of practitioners of the social professions needs to be explicitly reflected upon and practitioners need to have access to training that allows them to increase their understanding and skills with regard to ethical challenges and potential management of these challenges in situ.

References:

Adams, K., Encarnação, P., Rios-Rincón, A. M., & Cook, A. M. (2018). Will artificial intelligence be a blessing or concern in assistive robots for play? *Revista Brasileira de Crescimento e Desenvolvimento Humano*, *28*(2), 213–218. Retrieved from aph.

Alaiad, A., & Zhou, L. (2014). The determinants of home healthcare robots adoption: An empirical investigation. *International Journal of Medical Informatics*, *83*(11), 825–840. Retrieved from aph.

Chimirri, N. A., Andersen, M. L. Jensen, T., Kristiansen, A. E. W. & Søndergaard, D. M., (2018), Concerned with Computer Games: A Collective Analysis of Being and Becoming Gamer in Denmark. *Cultures of Computer Game Concerns : The Child Across Families, Law, Science and Industry*. Sørensen, E. (red.). Bielefeld: Transcript Verlag, s. 327-348

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19–32. https://doi.org/10.1080/1364557032000119616

Arnold, Thomas, & Scheutz, M. (2017). The Tactile Ethics of Soft Robotics: Designing Wisely for Human-Robot Interaction. *Soft Robotics*, *4*(2), 81–87. https://doi.org/10.1089/soro.2017.0032

Arnold, T. (2017). Beyond Moral Dilemmas: Exploring the Ethical Landscape in HRI. *ACM/IEEE International Conference on Human-Robot Interaction*, 445–452. https://doi.org/10.1145/2909824.3020255

Arnold, T. (2018). Observing Robot Touch in Context: How Does Touch and Attitude Affect Perceptions of a Robot's Social Qualities? *ACM/IEEE International Conference on Human-Robot Interaction*, 352–360. https://doi.org/10.1145/3171221.3171263

Baisch, S., Kolling, T., Rühl, S., Klein, B., Pantel, J., Oswald, F., & Knopf, M. (2018). [Emotional robots in a nursing context : Empirical analysis of the present use and the effects of Paro and Pleo]. *Zeitschrift Fur Gerontologie Und Geriatrie*, *51*(1), 16–24. https://doi.org/10.1007/s00391-017-1346-8

Barad, K. (2007). Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning. Durham: Duke University Press.

Bedaf, S., Gelderblom, G. J., & de Witte, L. (2015). Overview and Categorization of Robots Supporting Independent Living of Elderly People: What Activities Do They Support and How Far Have They Developed. *Assistive Technology*, *27*(2), 88–100. https://doi.org/10.1080/10400435.2014.978916

Behrendt, M. (2017). *Reflections on Moral Challenges Posed by a Therapeutic Childlike Sexbot.* 96–113. Cham: Springer.

Belpaeme, T., Baxter, P., De Greeff, J., Kennedy, J., Read, R., Looije, R. & Zelati, M. C. (2013). Child-robot interaction: Perspectives and challenges. In *International Conference on Social Robotics* (pp. 452–459). Cham: Springer International Publishing.

Belpaeme, T., & Morse, A. (2010). Time will tell— Why it is too early to worry. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 191–195. https://doi.org/10.1075/is.11.2.02bel

Bendel, O. (2015). Surgical, therapeutic, nursing and sex robots in machine and information ethics. In S. P. van Rysewyk & M. Pontier (Eds.), *Machine medical ethics.* (pp. 17–32). https://doi.org/10.1007/978-3-319-08108-3_2

Bickmore, T., & Gruber, A. (2010). Relational agents in clinical psychiatry. *Harvard Review of Psychiatry*, *18*(2), 119–130. https://doi.org/10.3109/10673221003707538

Billard, A. (2017). On the mechanical, cognitive and sociable facets of human compliance and their robotic counterparts. *Robotics & Autonomous Systems*, *88*, 157–164. Retrieved from aph.

Blackman, T. (2013). Care robots for the supermarket shelf: a product gap in assistive technologies. *Ageing & Society*, *33*(5), 763–781. https://doi.org/10.1017/S0144686X1200027X

Boddington, P. (2017). EPSRC Principles of Robotics: commentary on safety, robots as products, and responsibility. *Connection Science*, *29*(2), 170–176. https://doi.org/10.1080/09540091.2016.1271396

Bogue, R. (2013). Robots to aid the disabled and the elderly. *Industrial Robot*, *40*(6), 519–524. Retrieved from aci.

Borenstein, Jason. (2012). Robotics, ethics, and the environment. *International Journal of Technoethics*, *3*(2), 17–29. https://doi.org/10.4018/jte.2012040103

Borenstein, Jason, & Arkin, R. (2016). Robotic Nudges: The Ethics of Engineering a More Socially Just Human Being. *Science And Engineering Ethics*, *22*(1), 31–46. https://doi.org/10.1007/s11948-015-9636-2

Borenstein, Jason, & Arkin, R. C. (2017). Nudging for good: robots and the ethical appropriateness of nurturing empathy and charitable behavior. *AI & Society*, *32*(4), 499–507. Retrieved from aph.

Borenstein, J. (2010). Robot caregivers: harbingers of expanded freedom for all? *Ethics & Information Technology*, *12*(3), 277–288. Retrieved from aci.

Buhtz, C., Paulicke, D., Hirt, J., Schwarz, K., Stoevesandt, D., Meyer, G., & Jahn, P. (2018). [Robotic systems for care at home: A scoping review]. *Zeitschrift Fur Evidenz,*

Fortbildung Und Qualitat Im Gesundheitswesen. https://doi.org/10.1016/j.zefq.2018.09.003

Castellano, G., & Peters, C. (2010). Socially perceptive robots: Challenges and concerns. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 201–207. https://doi.org/10.1075/is.11.2.04cas

Cath, C. (2018). Governing artificial intelligence: ethical, legal and technical opportunities and challenges. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *376*(2133), 20180080. https://doi.org/10.1098/rsta.2018.0080

Chen, C., Kehtarnavaz, N., & Jafari, R. (2014). A medication adherence monitoring system for pill bottles based on a wearable inertial sensor. . IEEE. *2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*.

Chiberska, D. (2018). The use of robotic animals in dementia care: challenges and ethical dilemmas. *Mental Health Practice*, *21*(10), 23–28. https://doi.org/10.7748/mhp.2018.e1342

Coeckelbergh, Mark. (2015). Good healthcare is in the 'how': The quality of care, the role of machines, and the need for new skills. In S. P. van Rysewyk & M. Pontier (Eds.), *Machine medical ethics.* (pp. 33–47). https://doi.org/10.1007/978-3-319-08108-3_3

Coeckelbergh, Mark. (2016). Care robots and the future of ICT-mediated elderly care: a response to doom scenarios. *AI & Society*, *31*(4), 455–462. https://doi.org/10.1007/s00146-015-0626-3

Coeckelbergh, Mark, Pop, C., Simut, R., Peca, A., Pintea, S., David, D., & Vanderborght, B. (2016). A Survey of Expectations About the Role of Robots in Robot-Assisted Therapy for Children with ASD: Ethical Acceptability, Trust, Sociability, Appearance, and

Attachment. *Science & Engineering Ethics*, *22*(1), 47–65. https://doi.org/10.1007/s11948-015-9649-x

Coeckelbergh, M (2009). Personal Robots, Appearance, and Human Good: A Methodological Reflection on Roboethics. *International Journal of Social Robotics*, *1*(3), 217–221. Retrieved from aci.

Coeckelbergh, M. (2018). How to describe and evaluate “deception” phenomena: recasting the metaphysics, ethics, and politics of ICTs in terms of magic and performance and taking a relational and narrative turn. *Ethics & Information Technology*, *20*(2), 71–85. https://doi.org/10.1007/s10676-017-9441-5

Cresswell, K., Cunningham-Burley, S., & Sheikh, A. (2018). Health Care Robotics: Qualitative Exploration of Key Challenges and Future Directions. *Journal of Medical Internet Research*, *20*(7), 408–417. Retrieved from aci.

Damiano, L., & Dumouchel, P. (2018). Anthropomorphism in Human-Robot Co-evolution. *Frontiers In Psychology*, *9*, 468–468. https://doi.org/10.3389/fpsyg.2018.00468

Damiano, L., Dumouchel, P., & Lehmann, H. (2015). Artificial empathy: An interdisciplinary investigation. *International Journal of Social Robotics*, *7*(1), 3–5. https://doi.org/10.1007/s12369-014-0259-6

de Graaf, M. M. A. (2016). An ethical evaluation of human–robot relationships. *International Journal of Social Robotics*, *8*(4), 589–598. https://doi.org/10.1007/s12369-016-0368-5

Decker, Michael. (2012). Service robots in the mirror of reflective research. *Poiesis & Praxis*, *9*(3/4), 181–200. Retrieved from aph.

Decker, Michael, Dillmann, R., Dreier, T., Fischer, M., Gutmann, M., Ott, I., & Spiecker genannt Döhmann, I. (2011). Service robotics: do you know your new companion?

Framing an interdisciplinary technology assessment. *Poiesis & Praxis*, *8*(1), 25–44. Retrieved from aph.

Decker, M. (2008). Caregiving robots and ethical reflection: the perspective of interdisciplinary technology assessment. *AI & Society*, *22*(3), 315–330. Retrieved from aci.

Del Casino, V. J. (2016). Social geographies II. *Progress in Human Geography*, *40*(6), 846–855. https://doi.org/10.1177/0309132515618807

Döring, N. (2017). Vom Internetsex zum Robotersex: Forschungsstand und Herausforderungen für die Sexualwissenschaft = From Internet sex to robot sex: State of research and challenges for the science of sexuality. *Zeitschrift Für Sexualforschung*, *30*(1), 35–93. https://doi.org/10.1055/s-0043-101471

Draper, H, & Sorell, T. (2017a). Ethical values and social care robots for older people: an international qualitative study. *Ethics & Information Technology*, *19*(1), 49–68. Retrieved from aci.

Draper, H. & Sorell, T. (2017b). Ethical values and social care robots for older people: an international qualitative study. *Ethics & Information Technology*, *19*(1), 49–68. Retrieved from aci.

Dympna Casey, Heike Felzmann, Geoff Pegman, Christos Kouroupetroglou, Kathy Murphy, Adaimantios Koumpis, & S. Whelan on behalf of the MARIO project. (2016). What people with dementia want: designing MARIO an acceptable robot companion. *Proceedings of the International Conference on Computers Helping People with Special Needs (Vol.1)*, *318–325*. Cham, Switzerland: Springer International Publishing.

Enz, S., M., Spielhagen, C., Zoll, C., & Vargas, P. (2011). The Social Role of Robots in the Future-Explorative Measurement of Hopes and Fears. *International Journal of Social Robotics*, *3*(3), 263–271. Retrieved from aci.

Espingardeiro, A. M. M. C. (2014a). *A roboethics framework for the development and introduction of social assistive robots in elderly care.* (University of Salford (United Kingdom)). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=109786648&site=ehost-live

Esteban, P. G., Hernandez Garcia, D., Lee, H. R., Chevalier, P., Baxter, P., & Bethel, C. (2018). Social Robots in Therapy: Focusing on Autonomy and Ethical Challenges. *ACM/IEEE International Conference on Human-Robot Interaction*, 391–392. https://doi.org/10.1145/3173386.3173562

Etzioni, A., & Etzioni, O. (2017). The ethics of robotic caregivers. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *18*(2), 174–190. https://doi.org/10.1075/is.18.2.02etz

Feil-Seifer, D., & Matarić, M. J. (2010). Dry your eyes: Examining the roles of robots for childcare applications. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 208–213. https://doi.org/10.1075/is.11.2.05fei

Feil-Seifer, D., Skinner, K., & Matarić, M. J. (2007). Benchmarks for evaluating socially assistive robotics. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *8*(3), 423–439. https://doi.org/10.1075/is.8.3.07fei

Filimon, D. (2018). *Capabilities of robotics applications in clinical rehabilitation and behavioral control* (ProQuest Information & Learning). Retrieved from

http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2018-34222-182&site=ehost-live

Fosch-Villaronga, E., & Heldeweg, M. (2018). 'Regulation, I presume?' said the robot – Towards an iterative regulatory process for robot governance. *Computer Law & Security Review*, *34*(6), 1258–1277. https://doi.org/10.1016/j.clsr.2018.09.001

Frennert, S. & Östlund, B. (2014). Review: Seven Matters of Concern of Social Robots and Older People. *International Journal of Social Robotics*, *6*(2), 299–310. Retrieved from aci.

Fridin, M. (2014). Kindergarten social assistive robot: First meeting and ethical issues. *Computers in Human Behavior*, *30*, 262–272. https://doi.org/10.1016/j.chb.2013.09.005

Fujita, M. (2001). AIBO: Toward the Era of Digital Creatures. *The International Journal of Robotics Research*, *20*(10), 781–794. https://doi.org/10.1177/02783640122068092

Génova, G., & González, M. R. (2017). Educational Encounters of the Third Kind. *Science And Engineering Ethics*, *23*(6), 1791–1800. https://doi.org/10.1007/s11948-016-9852-4

Gning, A., Davis, D. N., Cheng, Y., & Robinson, P. (2017). Analysis of the EPSRC Principles of Robotics in regard to key research topics. *Connection Science*, *29*(3), 249–253. https://doi.org/10.1080/09540091.2017.1323456

Gunkel, D. J. (2015). The rights of machines: Caring for robotic care-givers. In S. P. van Rysewyk & M. Pontier (Eds.), *Machine medical ethics.* (pp. 151–166). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2014-54594-010&site=ehost-live

H. R. Lee, J. Sung, S. Šabanović, & J. Han. (2012). Cultural design of domestic robots: A study of user expectations in Korea and the United States. *2012 IEEE RO-MAN: The 21st*

IEEE International Symposium on Robot and Human Interactive Communication, 803–808. https://doi.org/10.1109/ROMAN.2012.6343850

Hasse, C. & Blond, L (2017). *Designing Robots, Designing Social Practice.* WP

Hasebe, K., Kawamoto, H., Kamibayashi, K., & Matsushita, A. (2014). Safety and ethical issues in the development of human assistive robots. In Y. Sankai, K. Suzuki, & Y. Hasegawa (Eds.), *Cybernics: Fusion of human, machine and information systems.* (pp. 299–313). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2014-09504-015&site=ehost-live

Haraway, D. J. (1991). Simians, cyborgs, and women. The reinvention of Nature. London: Free Association Books.

Haraway, D. J. (1997). Modest_Witness@Second_Millenium. FemaleMan©_Meets_OncoMouse™. London: Free Association Books.

Haraway, D. (2016). Staying with the trouble. Making kin in the Chthulucene. London: Duke University Press.

Heerink, M., Vanderborght, B., Broekens, J., & Albó-Canals, J. (2016). New friends: Social robots in therapy and education. *International Journal of Social Robotics*, *8*(4), 443–444. https://doi.org/10.1007/s12369-016-0374-7

Hin-Yan, L., & Zawieska, K. (2017). From responsible robotics towards a human rights regime oriented to the challenges of robotics and artificial intelligence. *Ethics and Information Technology*, 1–13. https://doi.org/10.1007/s10676-017-9443-3

Howard, A., & Borenstein, J. (2018). The Ugly Truth About Ourselves and Our Robot Creations: The Problem of Bias and Social Inequity. *Science and Engineering Ethics*, *24*(5), 1521–1536. https://doi.org/10.1007/s11948-017-9975-2

Huber, A., Weiss, A., & Rauhala, M. (2016). The Ethical Risk of Attachment. *ACM/IEEE International Conference on Human-Robot Interaction*, 367–374. Retrieved from aci.

Huschilt, J., & Clune, L. (2012). The use of socially assistive robots for dementia care. *Journal Of Gerontological Nursing*, *38*(10), 15–19. https://doi.org/10.3928/00989134-20120911-02

Ienca, M., Jotterand, F., Elger, B., Caon, M., Pappagallo, A. S., Kressig, R. W., & Wangmo, T. (2017). Intelligent assistive technology for Alzheimer's disease and other dementias: A systematic review. *Journal of Alzheimer's Disease*, *56*(4), 1301–1340. https://doi.org/10.3233/JAD-161037

Ienca, M., Jotterand, F., Vică, C., & Elger, B. (2016). Social and assistive robotics in dementia care: Ethical recommendations for research and practice. *International Journal of Social Robotics*, *8*(4), 565–573. https://doi.org/10.1007/s12369-016-0366-7

Iosa, M., Morone, G., Cherubini, A., & Paolucci, S. (2016). The Three Laws of Neurorobotics: A Review on What Neurorehabilitation Robots Should Do for Patients and Clinicians. *Journal Of Medical And Biological Engineering*, *36*, 1–11. Retrieved from cmedm. (27069459)

Ishiguro, H. (2006). Android science: conscious and subconscious recognition. *Connection Science*, *18*(4), 319–332. https://doi.org/10.1080/09540090600873953

Jenkins, S., & Draper, H. (2015). Care, monitoring, and companionship: Views on care robots from older people and their carers. *International Journal of Social Robotics*, *7*(5), 673–683. https://doi.org/10.1007/s12369-015-0322-y

Kerruish, E. (2016). Perception, Imagination and Affect in Human- Robot Relationships. *Cultural Studies Review*, *22*(2), 4–20. https://doi.org/10.5130/csrv22i2.4823

Klein, B., & Schlömer, I. (2018). A robotic shower system: Acceptance and ethical issues. *Zeitschrift Für Gerontologie Und Geriatrie*, *51*(1), 25–31. https://doi.org/10.1007/s00391-017-1345-9

Körtner, T. (2016). Ethical challenges in the use of social service robots for elderly people. *Zeitschrift Fur Gerontologie Und Geriatrie*, *49*(4), 303–307. https://doi.org/10.1007/s00391-016-1066-5

Laryionava, K., & Gross, D. (2012). Deus ex machina or e-slave? Public perception of healthcare robotics in the German print media. *International Journal Of Technology Assessment In Health Care*, *28*(3), 265–270. https://doi.org/10.1017/S0266462312000293

Lehoux, P., & Grimard, D. (2018). When robots care: Public deliberations on how technology and humans may support independent living for older adults. *Social Science & Medicine*, *211*, 330–337. https://doi.org/10.1016/j.socscimed.2018.06.038

Lin P., Abney K., Bekey G. (2010). Robot ethics: Mapping the issues for a mechanized world. Artificial Intelligence, 175 (5–6), 942-949

Ljungblad, S., Nylander, S., & Nørgaard, M. (2011). Beyond speculative ethics in HRI? *ACM/IEEE International Conference on Human-Robot Interaction*, 191–192. Retrieved from aci.

Locsin, R., Purnell, M., Tanioka, T., & Osaka, K. (2011). Human rights and humanoid relationships in nursing and complexity science. In A. W. Davidson, M. A. Ray, & M. C. Turkel (Eds.), *Nursing, caring, and complexity science: For human–environment well-being.* (pp. 345–360). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2011-03121-015&site=ehost-live

Łukasik, S., Tobis, S., Wieczorowska-Tobis, K., & Suwalska, A. (2018). Could Robots Help Older People with Age-Related Nutritional Problems? Opinions of Potential Users. *International Journal Of Environmental Research And Public Health*, *15*(11). https://doi.org/10.3390/ijerph15112535

Matarić, M. J. (2006). Socially Assistive Robotics. *IEEE Intelligent Systems*, *21*(4), 81–83. Retrieved from aci.

Matthias, A. (2015). Robot Lies in Health Care: When Is Deception Morally Permissible? *Kennedy Institute Of Ethics Journal*, *25*(2), 169–192. https://doi.org/10.1353/ken.2015.0007

Meiland, F., Innes, A., Mountain, G., Robinson, L., van der Roest, H., García-Casal, J. A., ... & Kelly, F. (2017). Technologies to support community-dwelling persons with dementia: a position paper on issues regarding development, usability, effectiveness and cost-effectiveness, deployment, and ethics. *JMIR Rehabilitation and Assistive Technologies*, *4*(1), e1.

Mercer, J. (2010). Themes and variations in development: Can nanny-bots act like human caregivers? *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 233–237. https://doi.org/10.1075/is.11.2.09mer

Metzler, T. A., & Barnes, S. J. (2014). Three dialogues concerning robots in elder care. *Nursing Philosophy: An International Journal For Healthcare Professionals*, *15*(1), 4–13. https://doi.org/10.1111/nup.12027

Metzler, T. A., & Lewis, L. M. (n.d.). Ethical Views, Religious Views, and Acceptance of Robotic Applications: A Pilot Study. *Association for the Advancement of Artificial Intelligence*, *2008*, 15–22.

Metzler, T. A., Lewis, L. M., & Pope, L. C. (2016). Could robots become authentic companions in nursing care? *Nursing Philosophy*, *17*(1), 36–48. https://doi.org/10.1111/nup.12101

Misselhorn, C., Pompe, U., & Stapleton, M. (2013). Ethical considerations regarding the use of social robots in the fourth age. *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry*, *26*(2), 121–133. https://doi.org/10.1024/1662-9647/a000088

Moodly, T. (2017). Understanding social robotics. Robohub 24 January. (http://robohub.org/understanding-social-robotics/) - 06-21-2019

Moon, A., Danielson, P. (2012). Survey-Based Discussions on Morally Contentious Applications of Interactive Robotics. *International Journal of Social Robotics*, *4*(1), 77–96. Retrieved from aci.

Moyle, W., Beattie, E., Draper, B., Shum, D., Thalib, L., Jones, C., … Mervin, C. (2015). Effect of an interactive therapeutic robotic animal on engagement, mood states, agitation and psychotropic drug use in people with dementia: a cluster-randomised controlled trial protocol. *BMJ Open*, *5*(8), e009097–e009097. https://doi.org/10.1136/bmjopen-2015-009097

Moyle, W., Jones, C., Murfield, J., Thalib, L., Beattie, E., Shum, D., & Draper, B. (2017). Using a therapeutic companion robot for dementia symptoms in long-term care: reflections from a cluster-RCT. *Aging & Mental Health*, 1–8. https://doi.org/10.1080/13607863.2017.1421617

Müller, V. C. (2017a). Legal vs ethical obligations—A comment on the EPSRC's principles for robotics. *Connection Science*, *29*(2), 137–141. https://doi.org/10.1080/09540091.2016.1276516

Nitsch, V., & Popp, M. (2014). Emotions in robot psychology. *Biological Cybernetics*, *108*(5), 621–629. https://doi.org/10.1007/s00422-014-0594-6

Novikova, J. & Watts, L., l. (2015). Towards Artificial Emotions to Assist Social Coordination in HRI. *International Journal of Social Robotics*, *7*(1), 77–88. Retrieved from aci.

O'Brolcháin, F. (2017). Robots and people with dementia: Unintended consequences and moral hazard. *Nursing Ethics*, 969733017742960–969733017742960. https://doi.org/10.1177/0969733017742960

Oriel, E. (2014). Whom Would Animals Designate as 'Persons'? On Avoiding Anthropocentrism and Including Others. *Journal of Evolution & Technology*, *24*(3), 44–49. Retrieved from aph.

O'Sullivan, S., Nevejans, N., Allen, C., Blyth, A., Leonard, S., Pagallo, U., … Ashrafian, H. (2018). Legal, Regulatory and Ethical Frameworks or Standards for AI and Autonomous Robotic Surgery. *The International Journal Of Medical Robotics + Computer Assisted Surgery: MRCAS*, e1968–e1968. https://doi.org/10.1002/rcs.1968

Pagallo, U. (2018). Apples, oranges, robots: four misunderstandings in today's debate on the legal status of AI systems. *Philosophical Transactions. Series A, Mathematical, Physical, And Engineering Sciences*, *376*(2133). https://doi.org/10.1098/rsta.2018.0168

Palm, E., Nordgren, A., Verweij, M., & Collste, G. (2013). Ethically sound technology? Guidelines for interactive ethical assessment of personal health monitoring. *Studies In Health Technology And Informatics*, *187*, 105–114. Retrieved from cmedm. (23920461)

PARKS, J. A. (2010). Lifting the Burden of Women's Care Work: Should Robots Replace the 'Human Touch'? *Hypatia*, *25*(1), 100–120. Retrieved from aph.

Parks, J. A. (2015). Home-Based Care, Technology, and the Maintenance of Selves. *HEC Forum*, *27*(2), 127–141. https://doi.org/10.1007/s10730-015-9278-4

Pearson, Y., & Borenstein, J. (2013). The intervention of robot caregivers and the cultivation of children's capability to play. *Science And Engineering Ethics*, *19*(1), 123–137. https://doi.org/10.1007/s11948-011-9309-8

Pearson, Y., & Borenstein, J. (2014). Creating 'companions' for children: the ethics of designing esthetic features for robots. *AI & Society*, *29*(1), 23–31. Retrieved from aph.

Peca, A., & Coeckelbergh, M., Simut, R., Costescu, C., Pintea, S., David, D., Vanderborght, B. (2016). Robot Enhanced Therapy for Children with Autism Disorders: Measuring Ethical Acceptability. *IEEE Technology & Society Magazine*, *35*(2), 54–66. Retrieved from aph.

Petters, D., Waters, E., & Schönbrodt, F. (2010). Strange carers: Robots as attachment figures and aids to parenting. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 246–252. https://doi.org/10.1075/is.11.2.11pet

Pilotto, A., Boi, R., & Petermans, J. (2018). Technology in geriatrics. *Age & Ageing*, *47*(6), 771–774. https://doi.org/10.1093/ageing/afy026

Prescott, T. J. (2017). Robots are not just tools. *Connection Science*, *29*(2), 142–149. https://doi.org/10.1080/09540091.2017.1279125

Preuß, D., & Legal, F. (2017). Living with the animals: Animal or robotic companions for the elderly in smart homes? *Journal of Medical Ethics: Journal of the Institute of Medical Ethics*, *43*(6), 407–410. https://doi.org/10.1136/medethics-2016-103603

Rantanen, T., Lehto, P., Vuorinen, P., & Coco, K. (2018). The adoption of care robots in home care—A survey on the attitudes of Finnish home care personnel. *Journal of Clinical Nursing*, *27*(9/10), 1846–1859. https://doi.org/10.1111/jocn.14355

Rashidi, P., & Mihailidis, A. (2012). A survey on ambient-assisted living tools for older adults. *IEEE Journal of Biomedical and Health Informatics*, *17*(3).

Richardson, K., Coeckelbergh, M., Wakunuma, K., Billing, E., Ziemke, T., Gomez, P., … Belpaeme, T. (2018). Robot Enhanced Therapy for Children with Autism (DREAM): A Social Model of Autism. *IEEE Technology & Society Magazine*, *37*(1), 30–39. https://doi.org/10.1109/MTS.2018.2795096

Riek, L. D. (2016). Robotics technology in mental health care. In D. D. Luxton (Ed.), *Artificial intelligence in behavioral and mental health care.* (pp. 185–203). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2016-22282-008&site=ehost-live

Rigaud, A.-S., Pino, M., Wu, Y.-H., DE Rotrou, J., Boulay, M., Seux, M.-L., … Lenoir, H. (2011). [Support for patients with Alzheimer's disease and their caregivers by gerontechnology]. *Geriatrie Et Psychologie Neuropsychiatrie Du Vieillissement*, *9*(1), 91–100. https://doi.org/10.1684/pnv.2010.0248

Rodogno, R. (2016). Social robots, fiction, and sentimentality. *Ethics & Information Technology*, *18*(4), 257–268. https://doi.org/10.1007/s10676-015-9371-z

Ruiz-del-Solar, J. (2010). Additional elements on the use of robots for childcare. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 253–256. https://doi.org/10.1075/is.11.2.12rui

Santoni de Sio, F., & van Wynsberghe, A. (2016). When Should We Use Care Robots? The Nature-of-Activities Approach. *Science & Engineering Ethics*, *22*(6), 1745–1760. https://doi.org/10.1007/s11948-015-9715-4

Schafer, B., & Edwards, L. (2017). "I spy, with my little sensor": fair data handling practices for robots between privacy, copyright and security. *Connection Science*, *29*(3), 200–209. Retrieved from aph.

Scheutz, M. & Arnold, T. (2016). Are We Ready for Sex Robots? *ACM/IEEE International Conference on Human-Robot Interaction*, 351–358. Retrieved from aci.

Sedenberg, E., Chuang, J., & Mulligan, D. (2016). Designing commercial therapeutic robots for privacy preserving systems and ethical research practices within the home. *International Journal of Social Robotics*, *8*(4), 575–587. https://doi.org/10.1007/s12369-016-0362-y

Serholt, S., Barendregt, W., Vasalou, A., Alves-Oliveira, P., Jones, A., Petisca, S., & Paiva, A. (2017). The case of classroom robots: teachers' deliberations on the ethical tensions. *AI & Society*, *32*(4), 613–631. Retrieved from aph.

Share, P., Pender, J. (2019). PRoSPEro pedagogy of robotics for the social professions in Europe. *Scoping paper: Regulation of AI and robotics*. (Manuscript in preparation).

Sharkey, Amanda, & Sharkey, N. (2011). Children, the Elderly, and Interactive Robots. *IEEE Robotics & Automation Magazine*, *18*(1), 32–38. Retrieved from aci.

Sharkey, A. & Sharkey, N. (2012). Granny and the robots: ethical issues in robot care for the elderly. *Ethics & Information Technology*, *14*(1), 27–40. Retrieved from aci.

Sharkey, N., & Sharkey, A. (2010). The crying shame of robot nannies: An ethical appraisal. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 161–190. https://doi.org/10.1075/is.11.2.01sha

Sharkey, N., & Sharkey, A. (2012). The eldercare factory. *Gerontology*, *58*(3), 282–288. https://doi.org/10.1159/000329483

Sharts-Hopko, N. C. (2014). The Coming Revolution in Personal Care Robotics. *Nursing Administration Quarterly*, *38*(1), 5–12. https://doi.org/10.1097/NAQ.0000000000000000

Sorell, T, & Draper, H. (2017). Second thoughts about privacy, safety and deception. *Connection Science*, *29*(3), 217–222. Retrieved from aph.

Sorell, T. E. & Draper, H. (2014a). Robot carers, ethics, and older people. *Ethics & Information Technology*, *16*(3), 183–195. Retrieved from aci.

Sparrow, R., & Sparrow, L. (2006). In the hands of machines? The future of aged care. *Minds and Machines*, *16*(2), 141–161. https://doi.org/10.1007/s11023-006-9030-6

Szollosy, M. (2017). EPSRC Principles of Robotics: Defending an obsolete human(ism)? *Connection Science*, *29*(2), 150–159. https://doi.org/10.1080/09540091.2017.1279126

Søgaard, V. F. (2019). Forældre for en babyrobot: Et sociologisk fokus på styring af forældreskab blandt marginaliserede unge (Unpublished PhD-dissertation). Aarhus University, Aarhus, DK

Tanaka, F. (2014). Robotics for supporting childhood education. In Y. Sankai, K. Suzuki, & Y. Hasegawa (Eds.), *Cybernics: Fusion of human, machine and information systems.* (pp. 185–195). https://doi.org/10.1007/978-4-431-54159-2_10

Tanaka, F., & Ghosh, M. (2011). The implementation of care-receiving robot at an english learning school for children. *ACM/IEEE International Conference on Human-Robot Interaction*, 265–266. Retrieved from aci.

Tanaka, F., & Kimura, T. (2010). Care-receiving robot as a tool of teachers in child education. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 263–268. https://doi.org/10.1075/is.11.2.14tan

The Swedish National Council on Medical Ethics (SMER, Sweden) (2017). Robots and Surveillance in Health Care of the Elderly - Ethical Aspects. *Jahrbuch Für Wissenschaft Und Ethik*, *21*(1), 445–452. Retrieved from aph.

Timur Beyan, Heike Felzmann, Mark Ryan, Niamh Lang, Oya Beyan. (2015). *H2020 MARIO D1.2. Ethics Framework,*.

Tobis, S., Salatino, C., Tapus, A., Suwalska, A., & Wieczorowska-Tobis, K. (2017). Opinions about robots in care for older people. *International Multidisciplinary Scientific Conference on Social Sciences & Arts SGEM*, 425–432. Retrieved from aph.

Torras, C. (2010). Robbie, the pioneer robot nanny: Science fiction helps develop ethical social opinion. *Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems*, *11*(2), 269–273. https://doi.org/10.1075/is.11.2.15tor

Tsun, M. T. K., Theng, L. B., Jo, H. S., & Hui, P. T. H. (2015). Robotics for assisting children with physical and cognitive disabilities. In L. B. Theng (Ed.), *Assistive technologies for physical and cognitive disabilities.* (pp. 78–120). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2015-11378-005&site=ehost-live

Vallès-Peris, N., Angulo, C., & Domènech, M. (2018). Children's Imaginaries of Human-Robot Interaction in Healthcare. *International Journal Of Environmental Research And Public Health*, *15*(5). https://doi.org/10.3390/ijerph15050970

Vallor, S. (2011). Carebots and caregivers: Sustaining the ethical ideal of care in the twenty-first century. *Philosophy & Technology*, *24(3)*(3), 251–268.

Vallverdú, J., & Casacuberta, D. (2015). Ethical and technical aspects of emotions to create empathy in medical machines. In S. P. van Rysewyk & M. Pontier (Eds.), *Machine medical ethics.* (pp. 341–362). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2014-54594-020&site=ehost-live

van der Plas, A., Smits, M., & Wehrmann, C. (2010). Beyond speculative robot ethics: a vision assessment study on the future of the robotic caretaker. *Accountability In Research*, *17*(6), 299–315. https://doi.org/10.1080/08989621.2010.524078

van Kemenade, M. A. M., & Konijn, E. A. (2018). Healthcare Students' Ethical Considerations of Care Robots in The Netherlands. *Applied Sciences (2076-3417)*, *8*(10), N.PAG-N.PAG. https://doi.org/10.3390/app8101712

van Wynsberghe, Aimee. (2013). Designing robots for care: care centered value-sensitive design. *Science And Engineering Ethics*, *19*(2), 407–433. https://doi.org/10.1007/s11948-011-9343-6

Vandemeulebroucke, T., de Casterlé, B. D., & Gastmans, C. (2018). How do older adults experience and perceive socially assistive robots in aged care: a systematic review of qualitative evidence. *Aging & Mental Health*, *22*(2), 149–167. https://doi.org/10.1080/13607863.2017.1286455

Vandemeulebroucke, T., Dierckx de Casterlé, B., & Gastmans, C. (2018). The use of care robots in aged care: A systematic review of argument-based ethics literature. *Archives of Gerontology & Geriatrics*, *74*, 15–25. https://doi.org/10.1016/j.archger.2017.08.014

Vanderelst, D., & Winfield, A. (2017). An architecture for ethical robots inspired by the simulation theory of cognition. *Cognitive Systems Research*. https://doi.org/10.1016/j.cogsys.2017.04.002

Voelker, R. (2005). Rehabilitation medicine welcomes a robotic revolution. *JAMA*, *294*(10), 1191–1195. Retrieved from cmedm. (16160125)

Voiculescu, A. (2017). Reflections on the EPSRC Principles of Robotics from the new far-side of the law. *Connection Science*, *29*(2), 160–169. https://doi.org/10.1080/09540091.2017.1313818

Wagner, A. R., Borenstein, J., & Howard, A. (2018). Overtrust in the Robotic Age: A contemporary ethical challenge. *Communications of the ACM*, *61*(9), 22–24. https://doi.org/10.1145/3241365

Wilson, J. R., Scheutz, M., & Briggs, G. (2016). Reflections on the design challenges prompted by affect-aware socially assistive robots. In M. Tkalčič, B. De Carolis, M. de Gemmis, A. Odić, & A. Košir (Eds.), *Emotions and personality in personalized services: Models, evaluation and applications.* (pp. 377–395). Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2016-40474-018&site=ehost-live

Winfield, A. (2011). Roboethics - for humans. *New Scientist*, *210*(2811), 32. Retrieved from Research Library. (869011054)

Wu, Y.-H., Fassert, C., & Rigaud, A.-S. (2012). Designing robots for the elderly: Appearance issue and beyond. *Archives of Gerontology & Geriatrics*, *54*(1), 121–126. Retrieved from aph.

Wu, Y.-H., Wrobel, J., Cornuet, M., Kerhervé, H., Damnée, S., & Rigaud, A.-S. (2014). Acceptance of an assistive robot in older adults: a mixed-method study of human-

robot interaction over a 1-month period in the Living Lab setting. *Clinical Interventions In Aging*, *9*, 801–811. https://doi.org/10.2147/CIA.S56435

Wynsberghe, A. (2016). Service robots, care ethics, and design. *Ethics & Information Technology*, *18*(4), 311–321. https://doi.org/10.1007/s10676-016-9409-x

Yueh-Hsuan Weng. (2010). Beyond Robot Ethics: On a Legislative Consortium for Social Robotics. *Advanced Robotics*, *24*(13), 1919–1926. Retrieved from aph.

Exclusive: Google to Buy Artificial Intelligence Startup DeepMind for $400M https://www.recode.net/2014/1/26/11622732/exclusive-google-to-buy-artificial-intelligence-startup-deepmind-for) – Retrieved 11.28.2018

Axon Launches First Artificial Intelligence Ethics Board for Public Safety; Promotes Responsible Development of AI Technologies (https://www.multivu.com/players/English/8012853-axon-artificial-intelligence-ai-ethics-board/) – Retrieved 11.28.2018