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'Social' robot and social relations in care settings: Undefined positionality and fixed temporality

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ABSTRACT

Socially assistive robots in eldercare settings, i.e. 'social' robots, are currently being promoted and studied, particularly in Japan. Among these studies, clinical evaluation of their effectiveness in experimental research predominates, while studies that critically and analytically describe relations between actors in long-term care settings where robots are present are growing but still scarce. In this paper, we argue that understanding how older adults facing the loss of autonomy and their caregivers interact with robots in relational terms is helpful to explain the usage and non-usage of, and eventual resistance to social robots entering into care settings. This is why, in order to understand human relationships with social robots in elder care homes, this paper combines a 'script' approach and a 'critical care' one. Based on content analysis of a unique set of reports on trials of a social robot in multiple care facilities in Japan from 2018 to 2020, as well as interviews with stakeholders and ethnographic observations conducted in 2022, we answer two questions: 1) how do social robots shape social relations of care? 2) how do social robots affect social relations between care professionals, care recipients and robots? We proceed to discuss two of the characteristics emphasised in the ethics of care and examine them in depth: the positional and temporal aspects. Our major result is that, while the robot was easily adaptable to care environments because its position in relationships is not defined, embedded clock time flow in the robot was objective and linear, which indicates that some robot-created situations were seen as problematic by actors in care settings.

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1. Introduction

In the context of increasing life expectancy, the growing number of older adults (OA) with cognitive impairment, as well as the scarcity of caregivers, are increasingly recognised as a serious, worldwide public concern, especially in industrialised countries [1]. There is rising optimism that technology will play a role in addressing these issues and the effects of technology as well as robots on OA is an increasingly important theme in geriatrics and gerontology. Some 'social' robots, such as animaloid robots, are deemed to have the potential to complement or replace pet therapy, a non-medical treatment of dementia care that the Alzheimer's Association in the United States recommends [2].[1]

In Japan, since 2015, the government's 'Society 5.0' science and technology policy strategy has suggested that technology, including big

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[1] Despite the numerous studies on social robots, there is no widely accepted definition of social robots. As in the case of social robots, it may be due to differing meanings of each term: 'social' and 'robot' [77].

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data and artificial intelligence, may well tackle the medical and care difficulties of OA with cognitive impairment [3,4].[2] Over the past twenty years, Japanese society has seen increasingly rapid advances in service robots and communication robots, contributing to the idea that Japan is a world leader in the development of robotic technologies for OA [5]. However, despite government initiatives and positive effects on OA reported in research, robots have not proven to be widely employed, at least in long-term care facilities (LTCF) [6].[3]

In this context, most studies in the field of geriatrics and gerontology have focused on the effectiveness of robots on difficulties that OA face [7–10]. Many of these studies have demonstrated the positive impact of robots mainly on OA but also on caregivers, at the level of individuals [11]. However, research so far has failed to resolve an important paradox: whilst studies demonstrate a relatively high effectiveness of robots, there remains a low rate of robot adoption in care settings. To date, there has been little agreement on what role robots can play in care settings. In particular, what is not yet clear is the impact on or the transformations of care relations at the level of social groups [11], in other words, caregivers and care receivers. This is because previous studies did not properly take into account the perspective of a politics of care as referring to both the act and relationship of arising survival needs and responding to them in a particular context and situation [12]. Care practices always involve at least two people: the person needing care (or to whom needs are attributed) and the person responding to them [13].

Our study aims to contribute to this growing area of research by addressing this gap in the literature, by focusing on relationships between care recipients, caregivers, and robots. This paper seeks to examine neglected aspects of relationality and explores, in particular, the position-related connectedness and the time-related connectedness between these actors in the care setting by highlighting the position, role/function differences of [14,15] and the tempo/rhythm differences of people and things [16]. Taking 'social' robots as a focal point throughout the paper and assuming that the inclusion of social robots influences relations in long-term care practices, we explore the two following research questions: 'how do social robots shape social relations of care?' and 'how do social robots affect social relations between care professionals, care recipients and robots?'. The first research question focuses on the way the robot develops and fosters close relationships between actors in the care setting, while the second sheds light on the effects of these relationships on care practices. We emphasize the relational nature of care in this paper since care is frequently thought of as an act, yet care can only occur between two entities: one that has needs and another that responds to those needs. The two questions are closely connected, with the second being a direct follow-up to the first main question. To investigate care practices involving social robots, we draw on the notion of 'script' [17–19], because, as evidenced by Science and Technology Studies (STS), it is particularly significant for assessing the relationship between humans and technologies without separating them and modifying the lexicon for each.

Our empirical strategy is to try to answer these questions by focusing on a case study of social robot trials in Japanese care settings. More precisely, the research data in this paper is drawn from three main sources; two-year trial reports obtained from a robot provider; semi-structured interviews with robot providers; and participant observation of trials conducted in LTCF.

This paper begins by introducing our theoretical approach. Then, it dwells on our data and methodology. It is followed by our key findings, which are organised according to the relationships as in the design and the relationships developed throughout the trial. Finally, in the discussion, in order to understand the actors' relationality in care settings, these findings are analysed through the notions of positionality and temporality.

2. Theoretical background

To investigate the use of technology in eldercare, two different approaches have been primarily adopted. The majority of studies have been quantitative and are essentially based on clinical, laboratory, or experimental investigations that study how technology might be used to solve problematic conditions such as social isolation [20–22], poor well-being [23–25] and depression [26]. For example, studies on therapeutic companion robots have found a rise in the frequency of interaction among older persons at the micro level [27,28]. The perceptions and the acceptability of OA and caregivers were also explored [29,30] and it has been shown that perspectives among them have recently shifted to the positive, with stronger hopes for telecare robotisation and fewer concerns about care robots' compatibility with personal values [31]. These studies see technology as an interventionist solution [32,33] and investigate human-robot relationships at the individual level [11].[4] In contrast, there is a growing body of literature that draws on STS insights and the majority of investigations have been empirical and observational in nature, including ethnographic inquiries into eldercare contexts [34,35]. Several studies have demonstrated the diversity of technology usage (and non-use) with respect to how one engages with and through technologies according to one's assumptions as well as expectations [36,37]. They investigated the complex arrangement of technologies, care professionals, and care recipients, contributing to the accumulation of empirical data on technology use in relational terms [38–40].

Publications that concentrate on studying actors and their relationship with and through technologies tend to adopt a 'script' approach. Possibly because if the relationship between caretakers, care recipients, and technology is considered, each arrangement using technical equipment requires distinct inspection in order to learn the forms of social relations it delivers [41]. The notion of 'script' [17–19] offers a fundamental methodological concept that helps explore and understand the relationality of actors and non-human actors, including technologies. Being an important and heuristic idea in social studies on the relationship between technology and people in the context of care [38,39,42–44], script is similar to a screenplay for a film or a play: the relationship between technology and people can be analysed like a script, a connection between technology and people envisioned by the designer. Because technology is usually intended bearing human behaviour in mind, the script framework can also provide insights into the designers' social values and norms. According to a detailed summary provided by Akrich and Latour (17), this concept is based on the linguistic notions of 'performance' (the operation of using language) and 'competence' (the ability to conform to grammatical rules). It asserts that competence and performance are endowed and distributed to knowledge and artefacts, i.e. science and technology, and a crisis or a trial can reveal the envisioned, prescribed functions of technologies. The authors clarify the difference between the two by explaining that action itself is 'defined by a list of performances through trials; from these performances are deduced a set of competencies with which the actant is endowed' [18]. They argue that scripts portray actors (or 'actants') and their behaviour as envisioned by the innovators' side and that comparing performance to scripts through actual conflicts, confrontations, and problematic situations is relevant in studying socio-technical relations.

There is a growing number of studies which use STS insights and

[2] See Ref. [78] for a discussion on the use of social robots from a policy standpoint.

[3] It is important to highlight that, unlike the healthcare sector, other sectors have seen an upward trend in robot use, as evidenced by international research on delivery robots [79] and advising robots [80].

[4] For more studies on ethical concerns with socially assistive robots, see Ref. [81].

describe the roles that technologies can play within these networks of people and objects in care settings. Winance studied disabled persons in the process of trying and selecting wheelchairs [45,46]. She analysed relations between the disabled person and the wheelchair in their context and implied that care entails adjusting the interaction and balancing the positions of each member of the collective, which has led to her proposition that care is shared work. Similarly, Pols and Moser [47] investigated technologies for OA in need of care and looked into the social ties forged between them, by targeting relevant representations such as the coldness of technology and the warmth of care as the research object. They have shown that technology is not necessarily always cold and that some OA felt warmth from and affection for technology, particularly social robots. Together, these studies, by challenging the idea of humans and non-humans in the different realms of existence in the way Latour did [48], show that the heterogeneous character of relationality plays an important role in understanding technologies in social settings.

However, recent studies have not been able to account for all aspects of relationality in care involving technologies. Considering care as 'an affective state, a material vital doing, and an ethico-political obligation' [49], this study adopts a 'critical care' approach to study technology [50,51], by examining ordinary and often neglected aspects of the relationships such as positional and temporal aspects of the care relationship from the perspective of a politics of care [52].[5] Positional characteristics of the care relationship have been studied [12,14,15] to explain how a symbolic power asymmetry might arise between those who need care and those who provide care. This positional asymmetry is regarded as unavoidable in the practice of care since individuals who respond to needs frequently have the option of whether or not to respond to those needs, whereas those who require care frequently do not, according to Sen's capacity perspective [53,54]. The temporal component of care practice is seen as one of the most pressing challenges in care practice. The reason for this is that care practice lasts (and it should be) as long as the person in need is satisfied, whereas, in group care, activities such as eating, bathing, and some recreational activities are completed on a tight timetable, resulting in relative temporal tensions [16]. In a 'critical care' approach, the 'affective state' of care can be investigated by the positional aspects of the relationships, while 'the material vital doing' of care may be examined by taking account of the temporal aspects of the relationships. Therefore, these two aspects cannot be overlooked and are deemed heuristic for exploring the relationship with and through robots.[6]

There are inspiring research examples in the field of social studies of science and technology that scrutinise care practices through a critical lens. Even though social robots show a certain degree of effectiveness in solving individual problems such as depression, interactions between humans and robots may yield some unexpected situations, resulting in some resistance to technologies. For example, ethnographic work in Japan provides evidence that this is because proponents of the technology, including the government, anticipate robots to be omnipotent, yet users in care settings perceive different realities of care from those of the proponents and become even antagonistic to robots [55]. A sociological work in France reveals that this is because, in the precisely located practice of care, robots do not always behave as expected, and both care recipients and carers must exert significant effort to engage in exchanges with the robot [56]. Overall, these studies highlight the need for empirical knowledge to demonstrate the ambivalence of deploying robots in care settings and a more nuanced discussion of what technologies can do in social life.

3. Data and methodology

We began by evaluating two-year reports on a small humanoid robot trial drafted by a staff member of the digital promotion department in a large for-profit Japanese telecommunication company. The reports were obtained from the staff member during the time we carried out participatory observation of the usage and non-usage of robots in LTCF in the Kanto region from April to July 2022. Contact with the robot provider was made through an online visiting tour of LTCF that introduced caring equipment and robots, organised in October 2021 as one of the public initiatives undertaken by the Department of Social Welfare in the same region. The aim of the document, according to the promotion staff member, was to report the free trials of the robot to the head robot development management team, and its production was a requirement for acquiring a robot and implementing free trials for sales promotion: there was no 'checking or amendment of the report'. The opportunity to have access to this information was highly valuable, and although such procedures may be difficult to replicate in the future, it would be unwise to dismiss such reports without considering them as an insightful source of material. Besides, through the digital promotion staff member, we obtained robot promotional material (one confidential, digital presentation material and one publicly available, printed material) and also consulted the robot overview website and the robot instruction manual website (which are both publicly available).

Trials were conducted before the pandemic, between April 2018 and March 2020, at 13 different facilities (9 day-service centres, 1 special care home, 1 geriatric health facility, 1 fee-based care home and 1 dementia group home). A single trial session was held at 11 different facilities (8 outpatient day long-term cares, an LTCF, a group home for the

Table 1
List of eldercare facility participants[a].

	Institution code names	Description of care homes	Service operators	Date of trial (YYYY-MM-DD)
1	TY	LTCF covered by public aid providing long-term care to the OA (*Tokuyo*)	Social welfare corporation	2018-04-06
2	DS01	Outpatient day long-term care (day service)	Social welfare corporation	2018-04-18
3	DS02	Outpatient day long-term care (day service)	Social welfare corporation	2018-04-24
4	DS03	Outpatient day long-term care (day service)	Social welfare corporation	2018-05-16
5	DS04	Outpatient day long-term care (day service)	Social welfare corporation	2018-06-15
6	GH	Group home for the OA with dementia	Social welfare corporation	2018-07-10
7	DS05	Outpatient day long-term care (day service)	Social welfare corporation	2018-07-18
8	DS06	Outpatient day long-term care (day service)	Medical corporation	2019-01-28
9	DS07	Outpatient day long-term care (day service)	For-profit corporation	2019-02-14
10	YRH	Fee-based LTCF (Yuryo Rojin Home)	Medical corporation	2019-03-08
11	DS08	Outpatient day long-term care (day service)	For-profit corporation	2019-03-25
12	DS09-01 … DS09-27 (27 times)	Outpatient day long-term care (day service)	For-profit corporation	2019-03-28 … 2020-03-26
13	RK-01 … RK-13 (13 times)	Long-term care health facility (*Roken*)	Medical corporation	2019-11-15 … 2020-02-12

[a] See the UN report on Japanese LTCF [84] for further information on the various categories of care homes and service operators in Japan (we also used the terminology described in the report).

[5] For a discussion on 'care studies' in STS with several approaches other than the 'critical care' approach, see Ref. [82].

[6] It should be noted that the temporalities mentioned in this study will be related to micro-interactional care activities. See Refs. [50,55,83] for discussions that examine another industrial or socio-technical inventive aspect of temporality.

OA with dementia and a fee-based LTCF), 27 sessions at an outpatient day long-term care, and 13 at a long-term care health facility (see Table 1). The 50-page reports included practical descriptions such as operational details of an approximately 1-h trial session and reactions of the prospective users, as well as the digital promotion staff member's thoughts (i.e. positive and negative judgements). The content was not a formal report, but more of a memo-like record of the staff member's own struggles and mistakes. These records were processed by qualitative content analysis and the corresponding code names were used for quotations from the reports (institution code followed by report element code). It should be noted that by the time this report was finished, none of the LTCFs had adopted the robot. No change has taken place as of the time of writing of this paper.

To supplement this data, two semi-structured interviews were conducted: one with the digital promotion staff member who granted access to the reports and the other with two of the robot's designers. The interviews took place in May 2020 and lasted 60 min. Since the robot promotion company (Kanagawa, Japan) and the robot design company (Osaka, Japan) are different entities, interviews with the former were conducted in the author's office (Tokyo, Japan) and with the latter via video call.

Interviews were recorded, transcribed, and converted to textual data. A grounded theory approach [57] was used for these textual data as well as for two-year trial reports to conduct inductive data analysis in order for themes to emerge from the data. In other words, the analysis was carried out using a form of thematic coding to classify and categorise the data.

In addition, to supplement the trial reports with triangulation forms, participant observations were conducted at sites where the robot was introduced with the help of the digital promotion staff member from April to July 2022. Four stints of participant observation were conducted, totalling 6 h in length. Two of them were performed at the mentioned facilities in the reports: the day-service centre and the geriatric health facility. We conducted the observation in the presence of the digital promotion staff member. During observation, we had informal conversations with care workers about the adoption of a robot but did not manage to gather from care recipients their perceptions of the interaction with robots. The authors translated trial reports, interview transcription and fieldnotes from Japanese to English.

In order to use the company's internal reports as research material, it was necessary to anonymise the robot, the digital promotion staff member and long-term care facilities. Thus, publications cannot be directly cited or referred to, though summaries will be provided. The names of the robot, Kuro and of the promotion staff member, Ken, are pseudonyms. All quoted statements were accompanied by their sources.[7]

4. Findings

4.1. Relationship between robots and care actors, 'prescribed' in the design

The robot is intended to help care professionals with light exercise and recreational activities and must be connected to the Internet, a set-top box, and a TV screen that displays activity materials such as still images and recorded video. In the robot's 'script', the aims of encouraging a group of care service users (usually at least four or more) to conduct light physical activities and mental activities were transcribed into the robot's action such as gesticulating, talking loudly and shifting attention in various directions. In particular, Kuro is configured to utter words in line with the participant's feelings, such as 'it feels good,' or words that are concerned about the participant's burden, such as 'it's indeed difficult' [the printed material]. As stated in the 'script', this might be required in order to 'realise a completely new, people-centred communication service' [the robotic company website].

Two significant themes emerged from the data on the robot supplier's side. First, from the robotic company's online materials, it is apparent that technologies, in their own right, provide possible answers to societal problems. The robot Kuro, a 'table-top size' that 'enables natural dialogue using words, gestures, and hand gestures', was designed with the goal of 'realising a society where people and robots can fully coexist' [the robotic company's website], which is essentially identical to the strategy outlined in the Japanese government's 5th Basic Plan, dubbed Society 5.0 [3]. The script here projects that robots may behave and act like persons to assist in resolving interpersonal problems. Furthermore, as the following interview with a robot designer demonstrates, efforts and research have been carried out with the assumption that robots will be a tool that can be used in care settings, in other words, they can play an active role. In the interview, the robot designer said:

> (My company and the company under the same group as the company Ken works for) initially started a joint research project to investigate whether it (a robot) could be used in the field of care and developed the robot and its additional application service dedicated to assisting with recreational activities in LTCF. [interview]

The script here shows the environment where the robot is assumed to behave as an autonomous entity. The script portrays an ideal relationship in which the human gets assistance from the robot, but it does not cover, for example, the relationship in which the human prepares the robot for operation or sets the robot's surroundings, which will be discussed later. A human-robot social bond envisioned in the script is one where the robot can act autonomously and assist the human in any environment.

The second type of relationship in the script is focused on the implementation of a collective endeavour such as recreation or rehabilitation. It is of a type that disregards the conditions of implementation, particularly the situation of the participants. Strong evidence of the assumption of the habitual, if not mechanical, nature of recreational time in institutional eldercare was found when the script emphasises the robot's automated process of interaction with humans. It is clear from the following excerpt that recreation is envisioned in the scripts as a unilateral action by the recreation executor. Data from the printed promotional brochure show that:

> (Kuro will) automatically conduct these [recreational] activities (in care settings) by employing incorporated cameras, microphones, speakers, and networking functions, as well as being highly integrated with IoT devices, cloud AI, and other devices. The service content includes exercise sessions, brain training, music, reminiscences, and games. [printed material]

Certainly, the use of robot-assisted recreation has a relatively positive impact on recreation participants. This is clear from an 'improvement in the residents' positive attitude towards interaction with others', according to findings of an empirical test conducted by a university professor [confidential digital material]. This is also supported by another trial, conducted from August to October 2015 by the company, which have brought about some positive evaluations of the robot from prospective users of 12 care professionals, resulting in three transformations in actual scenes of care:

> reducing the burden (of recreational activity preparation) (for care professionals), helping to solve the care staff shortage (for care facility directors), and improving satisfaction (for care recipients). [printed material]

However, in a setting where robots perform these recreational activities 'alone' and 'automatically', by 'taking the place of staff' [confidential digital material], it is assumed that recreation is a routine, an act that is repeated in institutional care, without taking into account

[7] A swift check was conducted, and no robot named Kuro was identified, therefore any reference to a robot called Kuro is accidental.

the psychological and physical well-being of the resident who is the participant of the recreational activities. Only the person in charge of delivering the recreation is present in the script, rendering residents somewhat invisible.

4.2. Partial 'performance' of the script in care setting: limitations 'described' throughout the trial

4.2.1. Harmonious but distant relation between the robot and recreation participants

The theme of harmony and a sense of unity recurred in Ken's report and one element to establish harmonious relations was Kuro's sound. This sense of unity might be simple to form, but it was evident from the reports that it was also easy to be disturbed, depending on the vocal sound of the ones who are spearheading the construction of togetherness. In two reports (trials done in April and May 2018), care professionals mentioned problems with Kuro's voice and associated television sounds which were too low to convey messages as issues to solve.

> It would be better if it [Kuro] were mobile, because [as it is] it would only reach about 10 participants around it. Because there are 20–30 people, in the day service [it] is difficult to implement [it]. Is it possible to use multiple robots at once? DS03-F38

> The sound volume/range is difficult to hear = low volume DS03-F39.

> Can it be used in multiple locations? TY01-F02

These points highlight how difficult it is for humans to adapt to the low volume of the robot, particularly in spaces where large groups of people spend time together, such as care settings. It also emphasises how difficult it is for a robot to adapt to humans because it requires additional equipment (for example speakers, as Ken recognised [DS01-F15]) and must overcome numerous obstacles, such as material connections, as discussed later. Taken together, even something as trivial as the volume of a machine appears to play a vital impact in the development of pleasant interactions that foster harmonious relations and a sense of togetherness, in institutional eldercare.

Indifference, then, can be viewed as a detriment to establishing a sense of unity. Ken was particularly interested in the robot's failure to conduct the recreational activities according to the programme and generate a 'harmonious relationship' between the participants, that is, a condition in which the participants perform the activities to the same degree. There were situations among the participants without excitement or indication of heightened mood and the word 'indifferently' was often used in Ken's reports [DS01-F12, DS03-E21, F23, F24, E35, DS04-F56, GH-E73, D79]:

> If (we) do not get a good start, a rec [recreational activity] is done indifferently. DS03F28

This usage underlines the fact that it was regarded as beneficial to do activities together, with everyone who shared Kuro's presence participating. Furthermore, indifference can cause some people to become detached from recreational time, bringing about a discordant state in the room. Ken wrote down situations where no prospective users, especially no resident, responded in their interaction with Kuro. Ken was keenly aware of the reactions of those around Kuro, as well as no reactions of them which was deemed undesirable by Ken. This implies that participating in recreational activities indifferently, such as when each person behaves independently or does not respond to any proposed movement, is deemed to limit the synchronisation of each participant's activity that encourages togetherness and constitutes detached and distant relations.

> (There are) about 2–3 people sleeping, although (they are) asymptomatic (service users of dementia). DS04-F49

> (There are) three people who appear to have dementia, one of whom is irritated by her leg pain, are unresponsive. YRH-F154

In establishing connections among seemingly indifferent participants, the gaze of Kuro and of the residents was also decisive during the observation. Kuro tried to engage in recreational activities in the same way that a care professional would, by looking around at the people who were closer to it. This was possible because Kuro was outfitted with a camera and speakers, which allowed it to perceive the current situation around it in a similar way that human eyes and ears do. The following is an excerpt from the field notes during participant observations in April 2022.

> Kuro, connected via a wireless connection to the TV screen, gave the impression that it was paying attention to its surroundings by turning its head to participants, in line with what a human instructor on a TV screen was performing. [field notes]

It was apparent from the observation that although Kuro tried to look at the people around it, the participants did not always look at the robot or make eye contact with it and the majority of the participants' eyes were, in fact, placed on the TV screen rather than the robot.[8] The gaze of Kuro was not met by the participants' gaze, which was difficult to describe as an interactional, reciprocal, bi-directional gaze. It was unclear whether this was due to the small size of the robot or the fact that the explanations of the exercises to be performed were provided by the video on the TV screen.

4.2.2. Pleasant but one-way communication between the robot and care recipients

The theme of detachment was also found during the observation. Certainly, some phrases mentioned above were heard from Kuro and they were unquestionably meant to share emotions and make the robot more pleasant and approachable. Nonetheless, neither OA facing the loss of autonomy nor care professionals responded to the words Kuro uttered. The following is an excerpt from the field notes during the participant observation.

> To get the rhythm going, the robot said 'one, two, one, two'. Because no one is speaking, its somewhat high-pitched, infantile voice stands out in the room. [field notes]

One reason for this may be that Kuro's facial expressions remained unchanged even when Kuro expressed emotions verbally. Kuro was described in the promotional material as accompanying the recreational activities through voice and words, but because of its one-way communication, it was unclear how much the prospective users would perceive that they were being accompanied (either by someone or by something).

Ordinary conversations are frequently limited in group care facilities among residents or between residents and care professionals, as in hospitals and clinics. The following quotations from the reports show expectations around the role robots play in communication. Ken even hoped that Kuro's utterances would spark a conversation. It is apparent from these quotations that, if communication is viewed as a means of expressing emotions and relating to each other, an instrument expanding communication options is hoped for.

> Next time, too, [if we can have] enough time for conversation, [it] will make it [Kuro] more approachable DS03-G30

> Kuro needs to be able to move around and interact with each person, and everyone should be encouraged to respond during the rec [recreational activities] DS04-D42

> Instead of Kuro indifferently presenting and answering questions, [Kuro] should be used as a starting point for establishing a dialogue (for example, what does this Chinese character mean? Tuna is the

[8] It was a female instructor on the screen who explained exercises showing actual body and hand gestures.

answer. Do you enjoy tuna? Do you like sushi? Do you enjoy fishing? [We should] enjoy various conversations while making the most of the internet. DS04- D56,

F56

Spoken exchanges are usually based on verbal and mutual relations. However, according to the report as well as the participant observation, the robot struggled to establish them with humans. Both Ken and prospective users believed that a conversation with Kuro, which is claimed to be a communication robot, would be effortless, probably considering the 'prescribed' relations outlined in 4.1. A situation was documented in which a care professional as a prospective user cited the difficulty of holding a conversation as one of the barriers to adopting Kuro, which was also understood and shared by Ken.

The conversation [with Kuro] was not smooth; when users spoke directly to Kuro, it did not receive an answer, and the dialogue was conducted through the robot operator [Ken].

[Ken's response] As previously stated, Kuro found it difficult to respond humanly, and it usually responds when the eyes are blue; improvements are planned in the near future to enable seamless dialogue. DS04-F60[9]

This quotation illustrates that the difficulty of establishing verbal and reciprocal relations between the robot and the human lies in the fact that the human must speak when Kuro's eyes are blue and modify his or her way of talking in order for the robot to understand. The distinction between such an attentional person and a person who requires long-term care is significant because the latter frequently has communication difficulties, particularly verbal communication due to hearing impairment. Since it was impossible for the robot to be adapted to the interlocutor, it was nearly impossible for the robot to become an interlocutor. The robot sought out familiar and everyday talks with residents, but instead, there was one-way engagement from either side.

4.2.3. Mechanical and functional connections between the robot and care professionals

One of the mechanical aspects of robots that automate recreational activities is that they follow a programme, making it almost impossible for them to adapt to the target audience. The duration of physical and cognitive activity for each resident is highlighted as problematic in the reports.

The following report quote from Ken's point of view in May 2018 refers to how long people need to practise physical exercises.

[What we accomplished] was not merely a video recreation, but a trial of Kuro's presence (Kuro's unique expression and space, as well as its realization). However, continuing for more than 30 minutes may be exhausting … DS03-F27

In addition, not taking into consideration the rhythm of a person's movement was also a concern. Both Kuro (with its dedicated service to OA facing the loss of autonomy) and the instructor on the TV screen were supposed to target them in LTCF, but there were still participants who moved their bodies at a different, slower pace than the robot and the instructor. Ken wrote in the report in replying to a care professional's comments on the difficultness of the exercises in the recreation:

(A)s long as we take into account previous trials, people with dementia cannot keep up with the exercises; it would be beneficial if the pace of the exercises could be slowed. DS04-F64

Robots are frequently connected to a variety of other technological objects. Although they can perform multiple roles and simulate human behaviour, they need physical and technical connections to function. These links are usually established in material terms, yet they are often considered problematic in specific situations.

While in most care settings, wheelchairs, walkers, and canes are widespread, technical objects that consume energy and must be recharged do not prevail, even though power plugs and cords are commonplace in our daily activities as a result of technological advancement and diffusion (such as personal mobile phones). Japanese eldercare homes usually have at least one large-screen TV for entertainment, but adopting some other technical device such as a robot appears quite a different matter and tricky. It is apparent from the observation that the placement of a robot could affect care relationships in which people go often from place to place, probably because a robot could be placed in the middle of the space while a TV set usually cannot. In the trial report, a care facility employee raised the following questions after trial sessions carried out in March 2019.

The power outlet is in the way, and the feet [of caregivers] could get mixed up with it, so it would be better if we could move the robot using storage batteries (similar views were expressed at other facilities). DS08–23, F23

Technical issues, which may be considered minor in the first step, can be perceived as a serious problem. When the person in charge of caregiving breaks off the relationship with the person in need of care and begins preparing to use the technology, it has an impact on the operation of activities in care homes, particularly when bathing, eating, and other activities take place at set times. Trial reports in June 2018 and January 2019 clearly showed the reasons for the difficulty of adopting the robot in a day-service centre.

The time it took to start the rec [recreational activities], the impact on work, and the fact that care is [provided] in time slots, and rec [recreational activities], meals, bathing, and so on [are] arranged, so the inability [for the robot] to start on time is a concern. DS-04, F58 (Kuro's) recreation was occasionally cancelled because images could not be displayed on a TV set (it [the TV] has an HDMI port, but data distribution was not possible) DS06-F132.

5. Discussion

So far, we have displayed findings organised according to the relationships 'prescribed' in the design and 'described' throughout the trial, through the methodological concept of 'script' [17–19]. As mentioned in the theoretical background, relationality, in particular positional asymmetry and temporal tensions, are crucial themes in the studies of robots that adopt a 'critical care' approach [12,49,52]. Based on this, the following section addresses the initial research questions, i.e. how social robots shape social relations of care and how social robots affect social relations between care professionals, care recipients and robots, by focusing on positional and temporal aspects of the relationships.

5.1. Relationship through positional aspects

First, this study showed that the robot's script included establishing interactions in care settings as a dialogue partner and a mood enhancer to create a harmonious relationship and a sense of unity. Even though the robot also unintentionally produced distance which was considered uncomfortable by Ken, care recipients as well as care professionals seemed to embrace the robot as a partner. A possible explanation for this might be that recreational time in institutional care is related to the notion of 'activity' and 'participation' rather than 'body function and structure' as the health condition suggested in the International Classification of Functioning, Disability and Health (ICF) by World Health Organization [58]. This is in line with Pols and Moser's findings that older people sometimes have positive feelings towards robots [47]. The observed non-refusal of both the caregiver and the care recipient may be

[9] Ken said in the interview in May 2022 that no improvement were implemented.

accounted for by the symbolic positional asymmetry that inevitably exists between caregivers and care recipients, as noted by care ethicists [59], because accepting the robot as a partner may reduce the degree of positional asymmetry for both parties by placing them in the same position relative to the robot.

A second important finding is that everyone in the scene, including residents and caregivers, was paying attention to the robot. Although positioned as an assistant to the instructor on the TV screen, Kuro, as a knowledgeable actor, takes a central rather than peripheral position during light exercise. The nature of knowledge ranged from cognitive quizzes or physical exercises, popular songs of yore, to historical events (such as the Tokyo Olympics in 1964) that many people were familiar with. This encyclopaedic knowledge favoured the robot's central position as a mood enhancer, maybe leading to peaceful and pleasant relationships with actors in the scene of eldercare facilities.

At first glance, the presence of this apparent 'helpful' robot to conduct collective activities seems to contradict Weber's study [60], which states that robots are usually designed to look helpless so that they are easily accepted. Even though the robot does not look like one of those artefacts 'which are gender-stereotyped as helpless women' [60], this robot indeed looks somewhat 'helpless'. While this robot looks genderless like some models shown by Schiebinger et al. [61], it seems to have been inspired by an infant because of its small size and its high-pitched voice. The present study went a step further, revealing that, despite its rather 'helpless' appearance, a helpful presence was assumed given how the robot was used and therefore when the robot was placed in front of the group of residents and care professionals, it became the participants' focal point. Care ethicists have recognised a similar positional asymmetry that can be explained by placing the care receiver and carer in a position that is either symbolically inferior or superior, with the former frequently in a dependent state [59]. It should be highlighted that our study has identified the symbolic and actual positions of the centre and the peripheral, with the former, the robot in our study, frequently drawing attention from the latter.

5.2. Relationship in temporal aspects, focusing on activities

The study found that the robot established a one-directional relationship with care recipients by not adapting the duration and speed of the exercises to the OA, causing problematic situations. Besides, the robot's script brought about functional relations with care professionals and the robot preparations such as the robot's material connections also raised issues by influencing the time flow of the LTCF. The findings confirm that providing care is first of all extremely context-dependent activity [62–64]. Both problematic situations might not have been viewed as such if the robot had gathered information about its own context, specifically for whom [65] or where and with whom it was doing what [66], rather than just acting on its own, based on its programme. It is all the more striking given that the definition of a robot often refers to an intelligent mechanical system 'with three technologies: a sensor, an intelligence/control system, and a driving system' [67], and robots can be 'viewed as socially helpful machines with three functions of 'feeling, thinking, and moving'' respectively [68].

These situations considered problematic support the view that the time running through care practices is primarily subjective in nature and cannot be measured, rather than objective time flow that can be measured [16,55,69]. This is especially because OA in need of care in LTCF can also be seen as an entity that, depending on the situation, can experience a potentially very destabilising physical and cognitive condition, at a great, particular pace [70,71]. Thus, the reason why the former situation of the robot's inability to adapt was deemed problematic may be explained by the fact that the temporal dimension of the robot dialogue was firmly based on objective and linear time. It was difficult for the robot to reply depending on the time it takes for each resident who could sometimes go through several phases of communication. Of course, the robot might also foster this type of interaction through what Davis refers to as 'process time,' [16] or 'kairological' time, a temporal aspect that is emphasised in care practices [69]. Certainly, it is indeed possible for the robot to encourage the person to spend less linear, more subjective time flow, as evidenced by the finding where participants not only listened to Kuro's chat about their youth but also were prompted to engage in conversation around it, seemingly losing track of time via the act of reminiscence. Kuro's programmed chat lasted only a few minutes, but the dialogues leading up to the narrative of each participant began suddenly and were terminated somehow, with no one noticing how long it lasted. Despite this, it should be noted that the robot simply produced the 'trigger' that gave rise to the relationship through process time, and the robot played a minor role on its own in this relationship. This conflictual temporalities between the robot's linear and regular rhythm and the residents' personal rhythm seem to be consistent with the idea of the difficulties in 'temporal alignment' [50] in socio-technical innovation and the idea of which rhythms adjust to which (and whose rhythms to whose) [72].

Furthermore, this study showed another nature of time in institutional care that flows through the rigorous schedule of carrying out various, often physical, activities as suggested by the idea of measurable and objective time flow in collective care [16,55].[10] The second condition of insufficient preparation for the robot was deemed problematic probably because the time required to make the robot perform consisted of, paradoxically, not straightforward, clear-cut time but compound process time. This seems especially true for care professionals, because of several back-and-forth steps to follow, which disrupted the linear time of institutional care practice composed of several varied process time related to each care act. One might propose that if there were no issues with the robot's preparation, there would exist a certain affinity in terms of time flow between institutional long-term care considered routine and the robot's operations. However, this would be possible on the condition that someone among care actors is ready to prepare, arrange and manage the connection with the robot or to materially 'take care of' robots [56,73], so that these actions do not conflict with the relationship with the care receiver established in the process time.

5.3. Social relations and practices of care, affected by social robots, from positional and temporal aspects

Even though these findings may be underpinned by the (constructed) robot-friendly nature of Japanese culture [74] and therefore require careful interpretation, it can be deduced from this that robots develop relationships through positional and temporal elements of the relationships (Fig. 1). On the one hand, the robot was configured to alternate between standing in the centre and aiming for an equal position as a dialogue partner. The robot was not designed to be placed in a clear, observable position in a relationship. It was 'inscribed' into the robot to build a relationship by freely adjusting the robot's position physically and symbolically.

On the other hand, it was also in the robot's script to develop relationships in the execution of recreation and communication activities through a relatively fast pace and regular rhythm. Certainly, the robot was configured to occasionally provide some opportunities to create social bonds between care professionals and care recipients through slow and leisurely moments. However, the robot rarely generated connectedness through the subjective and unpredictable rhythm in the recreational activities aimed at meeting the residents' socio-psychological requirements.

It may come as a surprise that when care professionals were to set up the robot for its function, they were unable to do so in a smooth time

[10] This is also consistent with the view that modern labour stresses measurable time and that such time is a central indicator of productivity that links labour (action) and workers (people), with productivity being the dominant argument for technology inclusion in care settings [85].

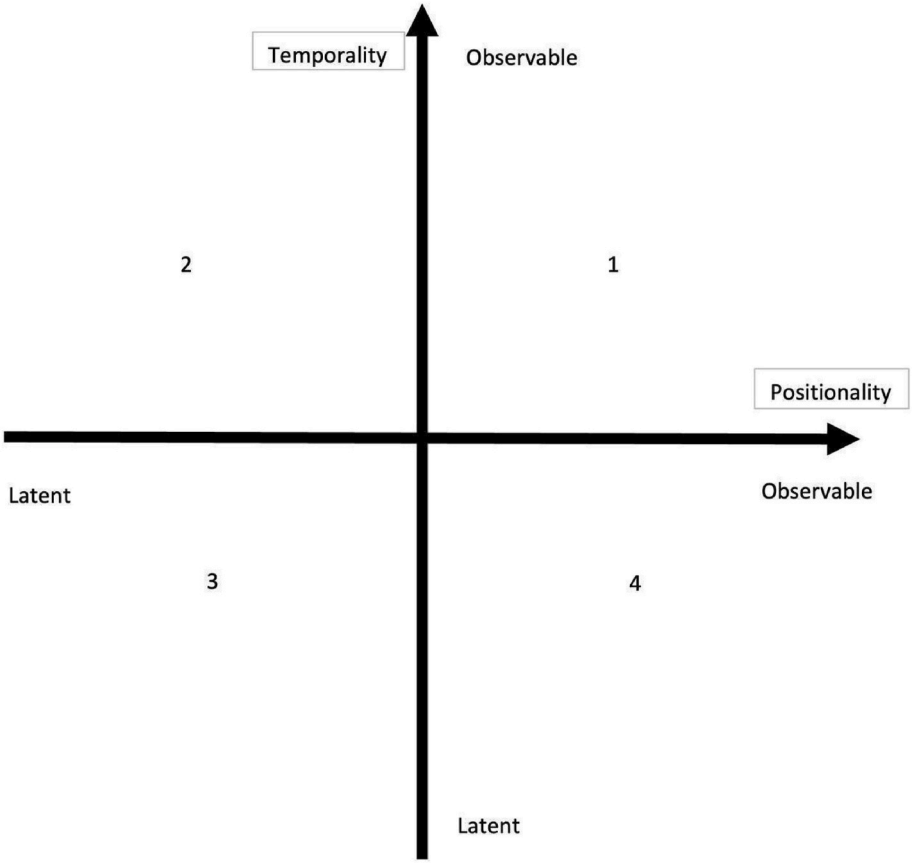

Fig. 1. Two-axis analysis of positionality and temporality (and its degree).

flow, and therefore constant and regular temporal elements in the relationships between the robot and the care professional were not observed. However, in this situation, the robot occupied the position of being 'cared for' by the care professionals, establishing a relationship with numerous stages of adjusting, connecting and modifying. This seemed to necessitate almost a course of action for the care professional, who currently lacks specialised expertise and experiential knowledge compared to robot providers, meaning less linear time flow but more processual time flow. Because an artefact's processual preparation time was only marginally associated with one fragment of care procedures, care professionals were unable to make room for it among other process time flow of personal physical care especially. Although care practices are already 'problematic because it involves social interactions that contain the potential for conflict' [75], this care arrangement with the robot produced even more conflictual time flow in collective eldercare, due to the excessively steady rhythm of the activity and the irregular and unfamiliar time flow of the robot's maintenance.

Based on these findings, it seems obvious that the robot's incorporation into care settings has caused even more difficulties in the temporal aspects of the relationships. As a result, it is possible to hypothesise that the conditions for a robot's admission into this seemingly straightforward but entangled care environment include not only considering the relationality of care but also a malleable positional relationship and a less observable and less predictable temporal relationship.

6. Conclusion

The purpose of this paper was to contribute to the ongoing research field on the use of socially assistive robots in eldercare settings. We have argued that it is fruitful to look at the relationships between OA, their caregivers and robots, by contrast to studies that focus on the individual scale. In order to understand human relationships with social robots in eldercare homes, we have combined a 'script' approach and a 'critical care' one. Based on content analysis of a unique set of reports on trials of a social robot in multiple care facilities in Japan from 2018 to 2020, as well as interviews with stakeholders and ethnographic observations conducted in 2022, we have tried to answer two questions: 1) how do social robots shape social relations of care? 2) how do social robots affect social relations between care professionals, care recipients and robots? By analysing relationships 'prescribed' in the design and 'described' throughout the trial and emphasising the positional and temporal aspects of the care relation, we have obtained the following major result: while robots are easier to adjust in terms of positionality because their position is not defined, embedded clock time flow in the robot was objective and linear, indicating that it was difficult to adjust in terms of temporality.

However, the findings in this study are subject to some limitations. First, the current study has mainly tackled the positional and temporal aspects of the relationships focused on the robot, instead of care service providers or recipients via the robot. It can only be speculated that, as we briefly mentioned in the Discussion section, the robot's intervention in conversation engagement may have sometimes increased the sense of togetherness and solidarity in less asymmetrical relationships between care providers and recipients as well as in less objective time flow. Second, we have not sufficiently examined how power relation and position are related to temporality in the case of technologies, as studies in other settings identified the link between the temporal character of actions and power in relationships [76].[11] Third, given that care is a selective form of attention, we could have addressed whether the social

[11] One classic study examining people in dominant positions and their temporalities is that of Bourdieu [86].

relations enacted by the robot cause some people or things to be excluded [34,52], and if so, who and what things are excluded. Still, this paper did not have the space to explore this topic.

Examining positional and temporal aspects of the relationships between OA in need of care, their care provider, and the robot will help identify the nature of their relationship and how it is affected by the inclusion of robots. This should help to explain why robots are often regarded favourably in studies at individual levels but not rated as such at the level of social groups, in this case, care setting actors. A future study investigating the interaction between OA in need of care and robots striving to care, by considering these actors as relational entities and focusing on their positionality and temporality in relationships, would be insightful to explain the underutilization of, and consequent resistance, to technologies.

CRediT authorship contribution statement

Yuko Tamaki Welply: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Sébastien Lechevalier:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization.

Declaration of competing interest

The authors report no conflicts of interest relating to this study.

Data availability

The authors do not have permission to share data.

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