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Robot Caregiver or Robot-Supported Caregiving?

The Performative Deployment of the Social Robot PARO in Dementia Care

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Abstract Much has been written—not least in this journal—about the potential, the benefits, and the risks of social robotics. Our paper is based on the social constructivist perspective that what a technology actually is can be decided only when it is applied. Using as an exemplar the robot baby seal PARO, which is deployed in Germany mainly as activation therapy for elderly people with dementia, we begin by briefly explaining why it is by no means clear at the beginning of the development phase what a technology is actually going to be. Rather, this is established in the light of, and in coordination with, the context of application. We then present some preliminary results from our ongoing study of the way in which this social robot is applied by professional care workers in a nursing home for the elderly. The underlying theoretical assumption on which our study is based is that the appearance and the performative deployment of a technical artifact are interdependent. Only in combination with experiences—the experiences of others, imparted in diverse forms as knowledge, and first-hand experience of using the technology—are the design and the technical functionality of the device of relevance to its appearance, that is, to what it is regarded as being. Our video-assisted ethnographic study of persons with dementia shows that, on the one hand, PARO is deployed performatively as an occasion for communication and as an interlocutor, and, on the other, it is applied as an observation instrument.

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1 Introduction

The robot seal PARO is a social, or "socially assistive" [1], robot that has already passed the prototype stage. In other words, it is no longer being built and tested at a service robotics R&D laboratory but is already being commercially marketed in—Japan since 2005 and in Europe and the U.S. since 2009. PARO is deployed mainly in nursing homes for the elderly especially in dementia units and occasionally in hospitals. Only in its country of origin, Japan, are over half (60 %) of the units sold owned by private customers [2, p. 2530]. To date, approximately 1,500 units have been sold worldwide: some 1,300 in Japan, 100 in Denmark, and 100 in other countries (see [3]). In contrast to other robots, therefore, PARO is not a bestseller on the (entertainment) robotics market. Nor is it intended to be, according to its designer, who stresses that he designed PARO as a handmade therapeutic instrument rather than a mass-produced consumer product, which is why he does not pursue a marketing strategy (personal communication on 14 February 2014). PARO's use as an artificial companion (cf. [4, p. 3]) by private individuals has taken second place. However, the robot seal has been finding its way into private households in Germany and Switzerland—encouraged by concerted efforts to deploy it during house calls within the framework of outpatient dementia care (cf. Demenzladen Basel, *Beziehungen pflegen*).

2 Technological Architecture

(Post)phenomenology does not define technology ontologically. In other words, it does not ask what a technical artifact is or what it can do not to mention what it 'does'. Rather, it defines technology according to how it appears to human consciousness.[1] Although the American postphenomenologist and philosopher of technology Ihde [6] emphasizes "appearance", he focuses on the ways in which technology is used. However, in our view, Ihde neglects the aspect of performance—that is, the actual execution of a projected act.[2] For, it is not just a question of "what it (the robot) does to us" [9, p. 219], but also what we do with it—or, more precisely, *how* we do something with it (cf. [10]).

Not only does PARO's robotic nature go unnoticed at first glance, but also the fact that it is a work of technology. For, because its zoomorphic shape is modeled after a baby harp seal, the technical system (*technisches* (*Sach*) *system*, [11]), which comprises a number of hard- and software components, is hidden beneath artificial white fur that has been treated with an anti-bacterial agent to comply with the hygiene requirements of its field of use, the health sector. Hence, before one notices its weight—approximately 2.7 kg—and the almost inaudible hum of its motors when it moves its 'head', 'eyelids', or 'flippers', ones first impression is that PARO is just a plush toy.

The hardware components of PARO's technical architecture include a variety of sensors, two loudspeakers, a number of actuators, and two 32 Bit CPU RISC processors.[3] As the central control unit, these processors form the core of the device (cf. [12]). In keeping with the expertise of its designer, PARO has five types of sensors: the posture sensor and the temperature sensor are located at the center of the device; there are two light sensors in the 'nose'; the 'whiskers' are touch-sensitive; and beneath the fur there is a "ubiquitous surface tactile sensor", which the designer describes as his own invention [13].[4] In addition, the device is equipped with auditory sensors, or microphones, with which sounds can be localized.

PARO's behavior generation system comprises two hierarchical layers of processes: proactive and reactive [14]. Prompted by sounds and other signals or stimuli, these processes are initiated through the interaction of the aforementioned hardware components with a behavior generation system based on a behavior model (software) and an underlying algorithm [12]. "Reactive behavior" means that the robot simulates reactions to a sudden stimulus, for example to a sudden loud sound [12, p. 2576]. "Proactive behavior", by contrast, refers to simulations that are generated by an "internal state system" (cf. [12, pp. 1054–1055]). PARO's proactive behavior is generated on two layers: a behavior-planning layer and a behavior-generation layer [14]. In robotic research in the social sciences in Germany, the extent of processes such as these is referred to as the "degree of automation" (*Selbsttaetigkeit*)[5] or "automatic control" (*Eigensteuerung*) of the technical artifact [16, p. 131].

With the help of actuators a type of motor that transforms signals or impulses into movement integrated in the 'eyelids', the 'neck', and the front and hind 'flippers' of the robot, systemic states are communicated to the user of the technology by means of *motor* expression. The interaction of the actuators with the tactile sensors conveys the impression that the robot can move its 'head', 'eyelids', and front and hind 'flippers' automatically, and that it therefore responds to touch.

In addition to motor expression, PARO's repertoire includes vocal expression. Various seal noises are simulated, which can be interpreted as signs of pleasure or displeasure. The microphones, which act as sound *receivers*, serve as a complement to the loudspeakers, which transmit electronically *generated* sound. The interplay between these auditory sensors and the actuators enables the 'head' to turn in the direction of sound sources, including the human voice, thereby conveying the impression of attentive listening.

In contrast to the tactile and auditory "channels" (cf. [17])—which are two-way channels, as it were—the visual channel is underdeveloped insofar as PARO is not equipped with a camera but merely has light sensors that enable a diurnal rhythm of morning, daytime, and night to be simulated. However, as the actuators on the eyelids cause the oversized—typical baby face—eyes to open and close, the observer can interpret this as 'seeing' or 'looking'.

Because PARO reacts when touched or spoken to—these technical functions are greatly enhanced by the thick fur that covers its seal-shaped body—it can be classified as an example of "emotional robotics" (cf. [18]), which stands in the tradition of "affective computing" [19].[6] For, on the one hand, PARO was designed with an emphasis on the display—in particular the vocal display—of 'emotional states' by the robot. And on the other, the design aims to arouse the impression that the robot is reacting to the emotions expressed, especially through tactile gestures, by the human counterpart.

[1] "What matters for the human–robot relation is how the robot appears to human consciousness" [5, p. 199].

[2] On the meaning of "performance" in the phenomenological sociology of knowledge, (cf. [7]); for an understanding of the execution of a projected act following the planning and decision phases, (cf. [8]).

[3] The advantage of these CPU processors is that they initiate processes very quickly, efficiently, and without any noticeable delay.

[4] These sensors were developed collaboratively with a company for Clinical Diagnostics.

[5] Cf. Knoblauch [15, p. 39], who uses the term *Selbsttaetigkeit* (automation) in relation to the movements of a divining rod.

[6] The designer himself considers the choice of "emotional" as a label for this research area to be unfortunate.

In the following, we shall outline PARO's location in the field of robotics in general, and in human–robot interaction (HRI) research in particular, on the basis of a brief account of its development process.

3 Technological Development

The development of the artificial baby harp seal PARO began in 1993 at Japan's National Institute of Advanced Industrial Science and Technology (AIST). Initially, research focused on so-called genetic algorithms for the effective control of mobile robotic systems in a variety of settings—not least in industry. The development of so-called aesthetic objects began against the disciplinary background of electronics and mechanical engineering. Aesthetic objects are defined as "artifacts that affect people mentally" [20, p. 1025, Fig. 1], [21, p. 169]. From a computer science perspective, this designation emphasizes that aesthetic objects are the exact opposite of "automatic machines" [20, p. 1025, Fig. 1] and heralds a new direction in robotics research.

3.1 PARO and the Paradigm Shift from AI to HRI

Between 1995 and 1998, while he was working at MIT's Artificial Intelligence Laboratory, the designer collaborated with Kazuyoshi Inoue and Robert Irie on the Artificial Emotional Creature Project, which aimed to "explore a new area in robotics" [22, p. 466]. Their research focused on HRI, and especially on the stimulation of emotions by robotic systems [22, p. 466].[7]

Hence, the development of PARO took place against the background of two innovations in the field of robotics: first, the establishment of social interactivity as a target at the technology development stage; and second, the related aspect of emotions—both the registering of the emotional state of the human user by means of tracking systems (sensors) and the simulation of the expression of emotions in, or by, the artifact itself. Both innovations took place in the context of a long-standing debate on intuitive user interface design (e.g. [24–26]), the implementation of artificial intelligence (AI) to control the behavior of mobile robotic systems [27], in particular the debate on autonomy (e.g. [28,29], and adaptive behavior control, e.g. [30]), and affective computing [19,31].

This focus was accompanied by a paradigm shift in the field of robotics, whereby robots are no longer regarded as convenient tools but rather as mechanisms of emotional HRI [22, p. 466].[8] This shift was also related to the fact that robotics increasingly distanced itself from "classical" AI research approaches and gradually moved closer to design-, acceptance-, and effectiveness research.[9]

3.2 Influence of Design-, Acceptance-, and Effectiveness Research on PARO

The choice of a zoomorphic design was informed by the desire to enhance HRI through emotional bonding [22, p. 466]. This approach was guided, first, by the argument that domestic pets are very common companions and are therefore familiar, and second, by the success stories in the area of animal-assisted therapy (AAT). In adopting this approach, the designer oriented himself toward the research strand of animal-like robotics within the debate on the design of social robots, which up to then had focused mainly on humanoid design (e.g. [40,41], [42, p. 1]).[10]

Contrary to the cultural–historical argument that people are used to dealing with domestic pets and are therefore capable of interpreting the behavior of an animal-like robot [42, p. 8], the designer, after evaluating various animal shapes (dog, cat, seal), came to the conclusion that a robot modeled after a non-familiar animal would meet with much greater acceptance ([12,20,21,32], [3, p. 382], [2, p. 2530]).[11] He thus endeavored to circumvent the problem that technical reproductions of familiar animals such as dogs and cats appear deficient in comparison to their live models and that they may also be rejected by people who have had negative experiences with these animals see also [47].

Hence, research on the acceptance of social robotics had an influence on PARO's design. The new paradigm of "robot believability" [48] follows the maxim that design elements should not arouse expectations that cannot be fulfilled.

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7 The results of the application of functional near-infrared spectroscopy (fNIRS) at Nihon University in order to investigate brain activities and functions in student subjects during interaction with PARO [23] are considered to be empirical confirmation of the fact that PARO is perceived as having emotions. In principle, the paradigm shift in the field of robotics, whereby robots are regarded as mechanisms of emotional HRI, has led to a change in the methods of scientific evaluation. Shibata et al. [22, p. 466] stress that subjective assessments rather than objective measures (such as speed, accuracy, etc.) are decisive for the evaluation of interactive, emotion-stimulating robots.

8 However, with regard to the purpose of such devices, the focus continues to be on the assistive function. As Shibata et al. [32, p. 444] stress, "the artificial emotional creatures exist to assist people in everyday life". Therefore, in contrast to the EU-funded HOBBIT project, which is based on such a mutual-care concept [33], these robots are not designed to care for humans and to be cared for in return.

9 Researchers from a diverse range of disciplines have dealt with AI and the possibility of imitating human thinking [(e.g. [34–36]), (cf. [37, p. 221])]. On the debate within AI research, cf. Meister [38]; on "the paradigm shift in AI", cf. also Brooks [39].

10 Drawing on cognitive science theories, such as simulation theory [43] and the theory of mind [44], researchers in the area of HRI design consider this empathy to be a basis for "expressive and rich interactions" with robots [45,46].

11 Shibata and Wada [3, p. 382] assign PARO to the second of the following three categories of animal-like robots (1) familiar animals, (2) non-familiar animals, and (3) imaginary animals or characters.

Analogous to the criticism of anthropomorphism in the field of human–computer interaction (HCI), this means that life-like reproductions should also be avoided when designing animal-like robots [42, p. 8]. The life-like agent hypothesis that a very life-like design enhances HRI [49,50] was succeeded by the "matching hypothesis", which states that the more appearance and behavior modeling conform to the expectations of the human interaction partners, the more successful interaction is [51], cf. also [52, p. 5].

After more and more studies reported positive effects of the robot seal in the area of care for the elderly—and especially in dementia care—the designer classified his prototype as a "mental commitment robot." In so doing, he and his team entered the relatively young specialized field of robot-assisted therapy: "The pet robots will be applied to heal people as mental commit (sic) robots" [20, p. 1024]. Later, the designer described these robots as "human interactive robots for psychological enrichment" [53, p. 1749], with the declared aim of providing a service "by interacting with humans while stimulating their minds" [53, p. 1749].

Over the last decade, the deployment of social robots to support therapeutic and activation interventions has established itself as a further research strand within HRI research by combining findings from the field of animal-assisted activity (AAA) and animal-assisted therapy (AAT) with the argument that the replacement of animals with technical artifact is advantageous (cf. [2, p. 2527ff], [3, p. 381], [54, p. 58], [42, p. 5], [55, p. 408]).

PARO is currently the most well-known representative of this young research field. This is due, on the one hand, to its relatively wide dissemination and, on the other, to the efforts of its designer to furnish tangible evidence of its potential effectiveness by means of quantitative and qualitative studies.[12] Effectiveness research generally focuses on the effects and potential of such technical artifact to bring about measurable health improvements [55, p. 414]. On the strength of a number of studies modeled after medical–pharmaceutical effectiveness research studies, the designer now expressly describes PARO as a device that can be used for the care of persons with dementia: "PARO is an advanced interactive robot developed by AIST, a leading Japanese industrial automation pioneer. It allows the documented benefits of animal therapy to be administered to patients in environments such as hospitals and extended care facilities where live animals present treatment or logistical difficulties" (www.parorobots.com).

3.3 PARO and the Shift in Perspective on Care Arrangements

As even this brief outline of PARO's development path clearly shows, the development of technology does not take place in a societal vacuum. Contrary to what linear models of innovation suggest, no technological product emerges 'fully formed' from the development stage and is then deployed in accordance with its intended purpose. Rather, technology is developed with the help of ideas and 'discoveries'—and even more so on the basis of existing possibilities and available personnel, financial, and material resources—and it is developed further in complex processes of negotiation with social groups (cf. [60]).

It can take years, or even decades, of development before a technology is ready for commercial application as a ready-to-use artifact. As a result of debate within and outside science, anticipated applications continually undergo changes, functions are extended, and the technological design is re-oriented toward specific trajectories within scientific-technological paradigms ([61,62], cf. also [38]).

Even though research and development takes place in laboratories at first, by the time the prototype is being built, at the latest, the technological development process becomes iteratively intertwined with possible application contexts. This is the typical course that modern innovation journeys take. At some point during this journey, external researchers—who are often from the humanities or the social sciences—start to observe the development of the new technology, while, at a societal level, debate on its risks, benefits, etc. intensifies. As a result, designers adapt or redefine the technology. Besides scientific aspects, economic considerations and public debate on social and demographic trends also play a considerable role in this regard [63].[13]

Hence, in the development context itself (cf. [65–67]) and in numerous publications on the development and application of social robots in geriatric care, reference is made to the challenges posed to society by demographic change a phenomenon that is often negatively connoted (cf. [68,69]). In this connection, the debate on the deployment of technology in general, and of social robots in particular, is characterized mainly by two normative topoi: the preservation of the autonomy of the sick and the elderly, and the support and substitution of human work in the context of long-term care (for an overview, cf. [70, p. 93ff]).

[12] PARO is not the only social robot designed for therapeutic use [56]. So-called "robotherapy" or "robotic psychology" [56, p. 1792], for example, employs the cat-like robot NeCoRo [56]. A teddy bear robot called the Huggable [57], which features a "sensitive skin" that detects very light touch, is deployed as a "therapeutic robotic companion for relational, affective touch" [55,58]. And the robot dog Homie, designed as an "artificial companion for elderly people", simulates various emotional states with the aim of facilitating emotional bonding [59, p. 1].

[13] Besides the model of innovation proposed by Van de Ven et al., research on technological development has yielded numerous other models for the analysis of the genesis of new technologies (cf. [64]).

Krings et al. [70, p. 105ff] reasonably advocate the replacement of this technology-push perspective with a demand-pull perspective in order to overcome the one-dimensional focus on the potential of the technology and to focus on the needs of elderly people, who should be perceived as being integrated in a complex system of arrangements for long-term care. These arrangements are interlinkages of professional and informal activities, employment relationships, cultural orientations, and technical equipment, in which technology is therefore only one of many factors [70, p. 75]. In order to emphasize the relevance of the technical artifact in a socio-technical arrangement, Haeussling [71] refers to the design concept (see below).

4 Sociological Research Question

In what follows, we shall not be commenting on the potential therapeutic effectiveness of PARO, which numerous studies[14] have endeavored to prove by means of physiological and psychological testing.[15] Nor shall we be venturing to assess the risks associated with the deployment of the robot in caregiving settings (cf. [70]). For, as sociologists, we do not furnish evidence of technological effectiveness, nor do we conduct technology assessment (TA) that is, assessment of whether robotics is ethically, economically, or therapeutically justifiable. Rather, we endeavor to understand the social order into which humans are integrated and which is, at the same time, a product of human activity. In so doing, we do not look at society through a wide-angle lens. Instead, we zoom in on the institutional framework and the organizational constellations under specific socio-historical conditions and focus on situative encounters between the individuals who make up the universe of interest to us as sociologists—namely, the social world.

When we deal with *technology* in our capacity as sociologists, we are interested in its connection with the social world. The general view of this relation is that every society has its ‘own’ technology and that, figuratively speaking, every technology is an expression of its time. From this perspective—and in view of the fact that social robotics, with its promise of interaction or even partnership, has very high social ambitions—one would ask: What kind of society brings forth this kind of technology?

However, rather than taking a correlative perspective, our viewpoint is one that integrates the technical and the social in such a way that “the technical is always socially constructed and the social is always technically constructed” [72, p. 273f]. Viewed from this perspective, technical artifacts must be treated not only as engineering constructions but also as social constructions, and social formations must be examined in the context of the technical relations that stabilize them.

Following Bijker ([72, p. 326]), we consider concepts such as “(socio-)technical system” and “actor/actant-network” ([73], cf. also [74]) to be problematic because of the notion of order inherent in the systems concept and the unboundedness inherent in the network concept. Hughes [75] describes the electric light and power system as a complex system of interconnected and clearly identifiable technical and social components, while Ropohl [11, p. 328ff] takes the notion of order one step further by explicitly using the concept of the socio-technical system to describe an “organized structure” (Popper 1960 cited in [11, p. 329]). This contrasts sharply with the equally problematic unboundedness characteristic of the network concept. The problem with the network concept is not that the principle of symmetry on which it is based erases the boundary between humans and non-humans. For this boundary is indeed socially constructed (cf. [76]). Rather, the problem is the price to be paid for portraying the socio-technical system as an actor/ actant network in which human and non-human actors must be described in the same terms [73], namely that processes of action and meaning–making are disappeared into a black box, at it were, thereby reifying them.

The advantage of Bijkers “sociotechnical ensemble” concept, which systematized the social construction of technology (SCOT) approach that he developed in collaboration with Pinch, is that it identifies a number of social groups involved in the social construction of the artifact, while at the same time placing the focus on the socially constructed technical artifact. However, unlike Latours actor-network-theory (ANT), Bijkers concept does not exalt artifacts to the rank of “non-human actors” [73]; nor does it demote them to mere props or to a “standing reserve” (Heidegger 1977, p. 77 cited in [75, p. 47]). However, the sociotechnical ensemble owes its clear structure to an empirically untenable selection of participant actor groups, who are observed in isolation from each other without taking their local and historical context into account, thereby leveling their potential influence [in relation to this criticism (see [77])].

A stronger focus on technology is manifest in Rammerts “sociotechnical constellation” concept [78]—a “network of heterogeneous elements and processes that form the operative context of the technology and determine the nature

[14] The period of investigation—in view of the novelty effect—and the problem of comparison groups are just two very striking problems that beset the research design of these studies. The artificiality of the experimental design, which is necessary to control other factors that could potentially influence the effect, basically cancels out the advantage that, in contrast to many other artifacts developed in this field, PARO has already been applied in professional caregiving settings.

[15] Apart from these studies, the alleged advantages of the robot seal compared, for example, to therapy animals are stressed by the distributors on online platforms and in deployment tests and demo videos that are available on the Internet.

and manner of its integration and effectiveness within the contexts of its use" ([79, p. 140], our translation). On the basis of a concept of gradual agency, Rammert argues from a pragmatistic perspective that agency is distributed between people, machines, and programs. Thus, "agency is really built into technologies as it is embodied in people" ([80, p. 6], emphasis in the original). Even though Rammert and Schulz-Schaeffer [79] developed their concept of "distributed agency" in explicit critical contradistinction to ANTs symmetry thesis (cf. [79, p. 140f]) and its concept of flat hierarchy [81], the fact that they use the concepts "interagency" and "interactivity" reveals that they have not completely abandoned the notion that machines act. By "interactivity" Rammert [82] means a form of social action through technology that is brought about by the interaction between action and technology (cf. [83, p. 308]).

Haeussling [71, p. 143], by contrast, places the design concept center stage. Explicitly following Rammert [78], he describes designers as "arrangers of social constellations". With the "arrangement" concept, Haeussling [71, p. 144] focuses on the nexus between the designedness of an object and its formative effect, which engenders "new social practices in everyday life" [84, p. 25] via the affordances provided by, and the individual appropriation of, technology. Applying a relational[16] perspective to Baeckers [86] systems theory approach, Haeussling postulates that design constitutes the interface—or the touch surface—between the non-social and the social, that is between the artificial–technical artifact and the person who uses it to position him- or herself. 'Touch' is meant literally here, as designers give the materiality of the object a shape and structure behind which they conceal its technical functions. They equip this shape and structure with symbols—that is, operating elements which are aimed at unambiguousness. Users carry out (fine) motor movements that, on the one hand, correspond to the design(ers) specifications and, on the other, are a meaningful element of self-willed performance.

Hence, a two-way relationship between the producer and the user comes about via the object. Haeussling [71, p. 151] understands the design process as communication on the part of the designer with an anticipated user, whereas Schuetz [87] differentiates the perspective of the user in such a way that he or she can see a designed object in a subjective or an objective meaning-context. The artifact can be interpreted as evidence (of what went on in the mind of the producer) or as a product (endowed with a general, that is a currently prevailing, sociohistorical meaning), whereby "as an objective meaning-context, as a product, it refers back to a highly anonymous ideal type of producer. (...) The artifact stands, as it were, at the end of the anonymization line in whose typifications the social world of contemporaries is constituted" ([87, p. 269], our translation).

When socio-technical arrangements are viewed from such a microperspective, the focus is on the (artificial) object. However, this object is not elevated to the status of an acting entity. Rather, by taking the objectivation process into account, it is linked to the actor who designed it, and integrated into the meaningful—cognitive and physical—acts of the actor who uses it. As a result, the object establishes a "They-relationship" (*Ihr-Beziehung*)[17] between these two types of actor. Analogous to the designers communication offer to the anticipated user, the use of the artifact can also be interpreted in the context of the user as an offer of communication.

In the case of interest to us here—the use of a technical artifact—this is not merely an offer of communication in the broadest sense of the word, for example in the sense of a status symbol. Rather, it is a very concrete offer of communication extended by one type of person to another. Our research in this regard focuses on the process of action—that is, the performance of the deployment of social robotics. This performance points to competence in the sense of a subjective dimension (quality) and a social dimension (appropriateness) of social action (cf. [89,90]). Both dimensions are passed on to others in the form of knowledge of how to handle the technical artifact correctly in order to achieve a certain intended effect. Technical artifacts are "objects in action" that require interpretation (cf. [83, p. 309]), and, moreover, technology must be understood as an institution (cf. [91]). The general questions that guide our project can be formulated as follows: How do people incorporate social robotics into their social interactions, thereby changing these interactions? In what way do people use social robotics in their everyday private and professional lives and in non-everyday situations,[18] thereby changing not only their everyday lives but also culture in the present context, the culture of professional caregiving, for example?

5 Methodological Remarks

Against the background of our basic sociological understanding, which integrates the social and the technical, what is

[16] Fuhse and Muetzel [85, p. 7] describe as "relational" those network research approaches that also adopt a cultural rather than a solely structural perspective on their research subject. In contrast to Baecker, Haeussling does not understand design merely as an interface between humans and technology but also as an "arrangement". By this he means a "social nexus that is formed and that forms" ([71, p. 144], our translation) and in which technology, consciousness, the body, and communication represent the central connection points.

[17] Schuetz [88, p. 210] distinguishes distant "They-relationships" between contemporaries, who are by definition "highly anonymous ideal types", and "We-relationships" between consociates.

[18] In non-everyday situations, we use robots as vehicles to cultural worlds of experience (cf. [10,92,93]).

of concrete interest to us in what follows is how—and as what—care workers deploy PARO, the "socially assistive" [1] robot, in a residential geriatric care setting, and especially in dementia care. Since the spring of 2013, we have been conducting long-term ethnographic research at a church-funded residential care center for the elderly in which two PARO units are being deployed. These units are applied exclusively by so-called "additional care workers" (*zusaetzliche Betreuungskraefte*), an occupation that was introduced only a few years ago. To qualify as an additional care worker, one must successfully complete a qualification measure comprising 160 h of instruction and a 2-week internship at a caregiving facility.[19] The qualification and the job tasks are regulated under section 87b of Book XI of the German Social Code [SGB]. As the job of additional care worker is not highly qualified, it can be classified as semi-professional.

In accordance with the *Richtlinien nach 87b Abs. 3 SGB XI zur Qualifikation und zu den Aufgaben von zustzlichen Betreuungskraeften in Pflegeheimen* [Guidelines under Section 87b Subsection 3 of Book XI of the German Social Code (SGB) Relating to the Qualification and Tasks of Additional Care Workers in Nursing Homes; our translation] of 19 August 2008, which are referred to in the following as the Betreuungskraefte-RI, the main task of these care workers is to "work closely and in professional consultation with the nursing staff and nursing teams to improve the quality of care and the quality of life of nursing home residents whose ability to cope with activities of daily living is severely and permanently restricted as a result of dementia-related incapacitation, mental illness, or mental disability, and who are therefore in need of a high level of supervision and care."

The fact that our research focuses on persons with dementia is not determined by our research question but rather by the situation encountered at the research site. The criterion for the selection of the research site was the deployment of PARO in practice as opposed to in a research laboratory or under artificial conditions. Most of the studies on PARO have been conducted under such controlled conditions either because no setting could be found in which PARO was being deployed in practice or because controlled conditions were considered to be an essential prerequisite for establishing its effectiveness.[20]

The deployment of PARO at our research site is also a 'test run' insofar as the use of a robot for the care and activation of nursing home residents is not explicitly mentioned on the list of care and activation measures in section 87b subsection 3 of the *Betreuungskraefte-RI*. However, this list of examples of the measures that care workers are expected to use to motivate nursing home residents to undertake activities of daily living [section 2 subsection 2, *Betreuungskraefte- RI*] is prefaced by a passage stating that, in principle, any "measures and activities that can positively influence the well-being, the physical condition, or the psychological mood of persons in care (may) be considered" [section 2 subsection 1, *Betreuungskraefte- RI*; our translation].

After the nursing home management decided to purchase PARO, and the church funding body approved this decision, two of the 'additional care workers' employed by the home underwent the 'introductory training' recommended and delivered by the distributor of the device in Germany. In addition, one of the two care workers attended a regional meeting of users, which served to exchange experiences. Moreover, the facility was given access to the distributor's 'interactive' e-learning platform, which is intended to replace individual on-site introductions in future. One of the two care workers has since changed employers. Before she left, she spent 2 h passing on to a third care worker the experiences she had gained when deploying PARO. Hence, the device is still being applied by two 'additional care workers'.

In the facility under research, PARO is by now firmly established among the many activation measures, which range from activation with singing bowls and Snoezelen therapy through 'reminiscence breakfasts', church services, theatre, and active groups, to activation with therapy dogs.[21] Like all other activation measures, the deployment of the robot within the framework of the activation program drawn up on a monthly basis is handled in a flexible way. In other words, its deployment depends on the availability of personnel and on other considerations. During the 1-year observation period, a rhythm of, on average, three PARO applications a month has become apparent. With just one exception, the situations in which PARO has been deployed have been so-called group-activation sessions. This is in keeping with the statutory guidelines, whereby "group activities [are] a suitable instrument for the prevention of social isolation that is threatened or has already occurred" (section 2 subsection 3, Betreuungskraefte- RI).

Participant observations and videographic documentation of this (group) activation with the robot seal constitute the

[19] The qualification measure is preceded by 5 days of practical work experience for orientation purposes. After they qualify, additional care workers are required to attend at least one further-training course per year [section 4 of the *Betreuungskraefte-RI*].

[20] Cf. by way of example the study currently being conducted by Moyle et al. [94]. In a pilot randomized controlled trial, Moyle and her team have already established the positive effect of PARO on the quality of life of nursing home residents with dementia.

[21] The facility cooperates with a dog-training school, which trains its dogs on site at the home under research to interact with elderly people and people with dementia. Moreover, one of the additional care workers deploys her own dog. (The animals suitability for deployment in this context was established beforehand).

core of our data material.[22] In order to be able to recognize the salient characteristics of this form of activation, we applied the principle of minimax contrasting to select measures for additional observation. From the broad range of activation measures we selected those measures that we deemed to be structurally similar (for example activation with therapy dogs or singing bowls) and those that are clearly different (reminiscence breakfasts, active group). Our body of data, which comprises approximately 15 h of video footage, 50 photos,[23] 20 recordings of informal conversations and team discussions, and 20 observation protocols, is currently being extended to include exploratory interviews with persons who are responsible for the activation of people with dementia, on the one hand, and for marketing and distributing the robot, on the other.[24]

When interpreting the audio data, transcripts of which are gradually becoming available, and the video data, which we examine straight away, we employ what is referred to in the hermeneutic sociology of knowledge (cf. [99]) as a "quasi-Socratic interpretation technique" [100, p. 215]. This technique entails confronting the interpreters everyday interpretation skills with the basic problem facing the social science interpreter—namely, to make transparent *how* he understands what he believes to understand, and how *he* knows what he thinks he knows. This succeeds best in a group setting, where the social scientist in question is requested to give his peers an exhaustive account of his (ad-hoc) interpretation of a text passage or a video sequence. The ensuing discourse prompts him to selfcritically reflect upon and, if necessary, revise the interpretation. Hence, collaborative interpretation in a group setting is an ideal solution (cf. [101]).

6 Results

In contrast to many other robots, PARO cannot move independently. This is of relevance for its handling as it cannot enter a room independently but must be carried in. We have empirically identified several different carrying techniques. This fact is worthy of mention because the possibilities for action created for the residents of the home vary according to the way in which the care workers carry the robot. None of the qualified care workers whom we have accompanied carry the device as if it were a mere accessory; and none of them would ever think of carrying it in its storage box. This observation does not allow any conclusions to be drawn about the subjective meaning that the care workers associate with their carrying techniques, which meaning can vary from individual to individual. However, one thing can be ruled out—namely, that they regard the artifact as a mere tool.

All the care workers carry PARO *demonstratively* in their arms, with the result that residents spontaneously talk, or react, to the device.[25] We call this '*activation in passing*'. It comes about particularly when the care worker slows her pace and when she has already switched the device on before the encounter. The so-called '*Fliegergriff*' technique caught our attention. It entails laying the robot seal along the forearm with the head nestling in the crook of the arm. Literally translated as the 'airplane hold', it is known in English as "the colic carry" or the "tiger-in-the-tree hold" and is employed to provide relief to babies suffering from colic. The advantage of this technique—as opposed to the more commonly used technique of carrying the robot under ones arm—is that the switch can be easily reached and the device can therefore be switched on relatively unobtrusively. This carrying technique is recommended during the operator training delivered by the distributor of the device.[26] The technique was applied—in other words, it was adopted as knowledge—by the care worker who qualified as a certified operator. She had been familiar with the technique beforehand as she had used it when her children were babies and it had proved its worth at the time.

When the care worker approaches a resident or a group of residents, this carrying act becomes a gestural act—namely, *proffering*. The transition from demonstrating to *proffering* is universal because, as our observations reveal, it occurs irrespective of the identity of the care worker or the resident. As long as the care worker proffers the device in this way, the residents situative attentiveness is ensured even if no con-

[22] Cf. Pfadenhauer and Grenz [95] on participant observation and Tuma et al. [96] on videography. Participant observation continually tends toward observant participation. Rather than being intended, this is determined by the situation in the field (cf. [97]) for example, when PARO cannot be deployed as planned because the additional care worker is on sick leave, and we find ourselves equipped with the device and sitting among residents of the home. In this case, instead of observation data, we acquire experiential data, which are particularly valuable with regard to the experience of lapses in communication and the use of PARO to overcome them.

[23] On visual protocoling within the framework of which photos acts as a form of knowledge, (cf. [98]).

[24] Our research acquires contextualization—the results of which cannot yet be reported here—by virtue of the fact that we are also studying the deployment of PARO during house calls within the framework of outpatient dementia care (home visit services in Germany and Switzerland). Moreover, we are interested in the (organizational and national) cultural differences in the way in which this artifact is used.

[25] Because of its size and color, PARO is hard to miss—provided, of course, one is a "normal, wide-awake adult" (Schuetzs term; on deviation from the norm as a result of dementia, (cf. [102]). However, if a person has impaired vision, which can be exacerbated in dementia patients by a decreased sensitivity to the color white, PARO may not be noticed.

[26] Germany is not the only country in which the distributors urge customers to take advantage of user training when they purchase PARO. Our ethnographic study confirms Pedersen's related to Denmark thesis [103, p. 44] that participants are trained not only in the correct application of the device but also in the correct attitude to the technology.

versation ensues. This *gestural sustaining* of *the situation*, which the care worker supports verbally and through her facial expression, creates a space for communication, which the resident *may*—but is not obliged to—avail of.[27]

Even when the care worker approaches residents who are seated in a seating area or at a table, and even when several persons in the group react to PARO, activation does not take the form of group activation. In other words, in contrast to the act of greeting, the care worker no longer addresses the group as a whole but rather one resident in particular for how long depends on the resident's reaction.[28]

Hence, even in the group setting, the deployment of PARO takes the form of individual activation. This activation may take a variety of forms. However, it makes a difference whether the care worker succeeds in making contact with the resident, in other words, whether the proffering of PARO, which is always accompanied by a direct address, prompts a reaction. This reaction may be, but need not be, due to PARO. Where contact is successfully established, we can contrast two variants of the deployment of the artifact. In the first case (Variant 1), the care worker continually presents a conversational stimulus, takes up a broken thread of conversation, encourages the resident to stroke PARO's fur, comments on its forms of expression, or invites the person to interpret them ("Do you think he likes that?"). In the second case (Variant 2), she holds back almost completely.

The first case resembles the typical course of everyday conversational situations in the presence of house pets: first, the pet is spoken to directly; this quickly gives way to a conversation about the animal; the conversation then switches to other topics; and it then switches back to the animal if its behavior attracts attention or the conversation falters (cf. [104]). In the second case, the attitude of the care worker resembles that of a psychoanalyst, who generates an artificial conversational atmosphere by means of a self-imposed reserve that evokes narration on the part of the analysand. In this situation, the care worker is not so much an interlocutor but rather an observer whose gaze switches back and forth between PARO and the resident. In this situation, the communicative burden on the care worker is lightened by the presence of the robot. This facilitates the kind of "free-floating attention" (*freischwebende Aufmerksamkeit*) that Freud describes as the necessary state of mind of the analyst during a psychoanalytic session: it is expressly not a question of focussing on a particular detail but rather of paying attention to all details (cf. [105, p. 89]). The care worker interprets the way in which the resident interprets PARO and whether the resident makes a connection between her (the residents) own actions and the (re)actions of the device.

In the same way as there is a typical seating arrangement in psychoanalysis—the analyst sits next to or behind (the head) of the analysand—the positioning of the care worker during the deployment of PARO is also significant. When assuming the role of observer, she typically squats down diagonally opposite the seated resident and can therefore focus both on PARO and, more importantly, on the face of the resident.

By contrast, the role of interlocutor is not characterized by a particular positioning. When the care worker exercises this role, the conversation is opened up to other residents. However, it is by no means only on the initiative of the care worker that the other residents are brought into the technology-mediated dyadic constellation. This also takes place on the initiative of the resident herself. This constellation may be regarded as "mediatized" [97] if one considers the robot to be media technology by means of which the original direct face-to-face constellation—and thus the experiences of the participant persons—changes. The fact that the role of the care worker has undergone differentiation, and that her role set now includes an observer role, could be a indication of this.

7 Discussion

We have observed two variants of the deployment of PARO. In one case, the care worker acts as a participant (in the conversation with the resident). In the other, she acts as an observer (of the resident's interaction with the robot). In the latter situation, the topic is typically selected by the resident—and not by the care worker, which is otherwise usually the case. For the purpose of interpreting these observations with a view to generalizing them, we consider a (post)phenomenological approach to technology to be helpful because it focuses on the ways in which technology is used, thereby rendering the "sensory-corporeal dimension of things accessible to analysis" ([106, p. 23]; our translation). More so than Ihde [6], we emphasize the importance of performance (the execution of the act of deploying a technical artifact) for appearance (what the artifact is regarded as being). From the perspective of a phenomenologically oriented sociology of knowledge—as opposed, for example, to a praxeological perspective—performance constitutes an entity comprising consciousness activity (meaning-establishment), the corporeality of the execution of the projected act, and the technical artifact, which is always endowed with meaning (knowledge).

Variant 1: Structurally speaking, the deployment of the technical artifact creates an occasion for conversation or even a situation in which the residents treat the robot as an inter-

[27] Throughout this paper we use feminine personal pronouns in relation to care workers and residents in order to make it clear that we were able to observe only female care workers and that the share of males among the residents is also very low. Hence, our data cannot be used as a basis for gender-specific statements.

[28] We have not yet been able to identify the selection criterion. However, it is probable that, because of the presence of the researcher, the selection is determined at least in part by a 'demonstration motive'.

locutor. The automation (Selbsttaetigkeit) that is characteristic of a robot constantly provides both participants with a potential topic of conversation to which they can refer should the conversation threaten to wane. However, in the case of persons with dementia, that is precisely what often brings encounters to an end—although the participants do not necessarily want this to happen.

In Variant 1, humans[29] and technology have what Ihde [6, p. 97] describes as an "alterity relation", in which technology displays a fascinating "quasi-otherness". As Ihde notes, "[w]hat makes it [technology] fascinating is this property of quasi-automation, the life of its own" [6, p. 100]. In addition to children's toys and computer games, Ihde explicitly uses the example of a robot, while taking care to distance his concept from the anthropomorphizing that is characteristic of AI research.[30]

It is not the advanced nature of the technology that is decisive for the establishment of alterity relations. Rather, it is its "disobedience"—which should not be equated with technical malfunctioning (cf. [6, p. 99]). Disobedience is, so to speak, the flip side of what roboticists call the systems "ability to learn". From the perspective of a care worker who uses the robot in a goal-directed way by incorporating it into the execution of her projected acts, the diverse output variants of the system may also be quite a challenge. The inability to predict whether PARO is going to do anything at all, and what he is going to 'do', is what brings the care workers to regard the conversational situation with the residents as special or out of the ordinary. However, the challenge posed by the situation should not be overlooked. We interpret our observation that the care workers are constantly stroking the device to be an indication of the strenuousness of their efforts to cope with PARO's "disobedience".

Variant 2: Structurally speaking, this variant of the deployment of the technical artifact creates an optional spatio-temporal communication setting (*Kommunikationszeitraum*), which the care worker sustains for a relatively long time. She does so performatively—that is, a) *physically*, through her posture and positioning, b) *gesturally*, by proffering the device to the resident and by touching it herself when placing it on the table in front of the resident or (rarely) on the resident's lap, c) through *facial expression*, that is through eye contact, and d) sometimes also *verbally*, by thematically referring to PARO.

In this variant, humans and technology have what Ihde [6, p. 80] calls a "hermeneutic relation", which means that technology helps the person to find out something about the world by producing signs that have to be interpreted. Ihde [6, p. 84] uses a thermometer as an example: the temperature cannot be apperceived directly but rather via symbolic representations (figures, calibration marks on the mercury column); and the necessary 'translation' effort is even more pronounced when the unit of measurement (e.g. Fahrenheit instead of Celsius or vice versa) is unfamiliar.

That the performative deployment of the robot seal constitutes "hermeneutic technics" is evidenced by the fact that, from the point of view of (one of) the care workers, what is special about this technology is that PARO—and only PARO—opens, or can be used to open, the "heart doors of memory" [Interview Oct. 2013]. By this, the care worker does not only mean access to particularly valuable biographic experiences that have been buried by dementia. According to our interpretatively acquired insight, "heart doors of memory" connotes the shimmering through of the personality—or the former "personal identity" [112]—of the resident in question, which is hidden by the disease.

"Hermeneutic transparency" in the "hermeneutic relation" corresponds to "disobedience" in the "alterity relation". Ihde [6, p. 82] uses the example of navigational chart reading to illustrate what he means by "hermeneutic transparency", noting that "[it] is apparent from the chart example that the chart itself becomes the object of perception while simultaneously referring beyond itself to what is not immediately seen". This manifests itself in the behavior of the care workers whom we have observed. On the one hand, they focus their attention on the robot's acoustic sounds and autonomous movements—that is, its "signs"—and, on the other, they look through them, as it were, and focus on the actions and reactions of the residents (cf. once again [106, p. 18]).

In this post-phenomenological understanding, it is indeed the human–technology relation that causes the appearance of something—namely, in the care workers view, the personality of the resident (here, too, cf. once again [5]).

8 Outlook

Our aim in this paper was to show how—and as what—care workers deploy PARO as an activation therapy for nursing home residents with dementia. In other words, we wanted to identify the kind of performance elicited by the special type of technology known as social robotics. We demonstrated how the care workers internalize knowledge on the one hand and generate different forms of communication on the other. The institutionalization of these forms of communication by virtue of their being passed on to, or adopted by, the next generation can already be observed. The main insight yielded by our study is that the combination of the deployment and the characteristic features of the technology

[29] In keeping with our research question, the term 'humans' refers here to the care workers. On the problems associated with gaining access to the perceptions of persons with dementia, (cf. [102,107]).

[30] Anthropomorphizing has been a controversial topic in HRI for some time now (cf. [108–111]).

performatively establishes a relatively stable spatio-temporal communication setting (*Kommunikationszeitraum*).

This spatio-temporal communication setting, in which the resident is under no pressure to act and the care worker is shielded from distraction, is based on an understructured situation. The "professional performance" [113] of the care worker is her self-imposed, deliberate reserve, without which the resident would be unable to act (as opposed to merely reacting). The fact that this variant (Variant 2) calls for an attitude that is special, non-routine, and strenuous could explain why it is observed less frequently than Variant 1 and is not applied by all three additional care workers observed by us. A systematic analysis is called for to determine when this is the case and whether it is dependent on certain persons or circumstances.

Our data contain nothing to suggest that PARO could be used to replace manpower—one of the fears voiced in the aforementioned robotics debate. This is due not least to the fact that it literally has to be carried into the caregiving situation, As we have endeavored to demonstrate, the robot is not a substitute for the additional care workers but rather supports them in their work in (at least) two different ways. Just as the deployment of robotics in industry can also be assessed in terms of the increase of productivity, so too could one ask in the further investigation whether its use as an observation instrument (Variant 2) improves the quality of caregiving insofar as it enables the care workers to find out more about those in need of care—including things that cannot be discovered by other means.

And although it might appear paradoxical at first glance, the integration of this kind of technology could indeed bring about a change in caregiving culture by pushing professional caregiving in the direction of the principle of self-determination enshrined in various legal norms—in Germany, for example, in section 2 subsection 2 of the Law on Long-Term Care Insurance [Book XI of the Social Code [SGB]; our translation]: "The aim of long-term care insurance benefits is to help those in need of care to lead as independent and self-determined a life as possible despite their need for care, which fulfils [the right to] human dignity." The deployment of PARO described in Variant 2 could make at least a small contribution to this because the creation of a spatio-temporal communication setting not only increases the chances of initiating a conversation in the first place. It also gives the residents a chance to select the topic of conversation to a certain extent.

We agree with Meister [114, p. 113] that further research in this setting is essential—in particular, research from an organization-sociology and sociology-of-professions perspective. As Meister notes: "What is evidentially missing are articles dealing with the meso-level, that is the consequences of an integration of robots in organizational settings. The introduction of a care-giving robot (e.g. PARO) will evidently not only create new human–robot interactions, but will also change the organizational setting in nursing homes with respect to workload, work description and hierarchies" [114, p. 113].

Our empirical research has indeed identified signs of tension between nursing and professional caregiving, in which the young occupational field of professional caregiving and activating must assert itself against the long-standing profession of nursing. It cannot be denied that technical artifacts such as PARO enhance the standing of caregiving and activating measures delivered by low-skilled "additional care workers". If these artifacts are recognized as therapeutic devices, which is something that is currently being driven ahead vigorously,[31] and if steps are taken to increase the qualifications of these care workers, this could give rise to a completely new balance of power.

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[31] In 2009, the U.S. Food and Drug Administration (FDA) certified PARO as a biofeedback medical device. The designer is currently lobbying for its recognition as a medical device in the European Union and Japan (cf. [2, p. 2537]).

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