Article

Assistant without Master? Some Conceptual Implications of Assistive Robotics in Health Care

Bettina-Johanna Krings * and Nora Weinberger

Institute for Technology Assessment and Systems Analysis, Karlsruhe Institute of Technology, P.O. Box 3640, D-76021 Karlsruhe, Germany; nora.weinberger@kit.edu

* Correspondence: bettina.johanna.krings@kit.edu; Tel.: +49-721-608-26347

Abstract: The subject of "technical assistants" in inpatient care is currently being widely discussed in scientific and public circles. In many cases, though, it has become apparent that the umbrella term "assistive technologies", also in the context of robotics, is very contrived. Against this background, the authors of this article reflect on the meaning of "assistance" in socio-technical systems, and critically review its relevance. To understand and demonstrate "assistive" functions, it is essential to establish a frame of reference. The re-evaluation of an empirical study of people with dementia in inpatient care has revealed the functional character of technical assistance systems. The results, however, show that the theoretical debate on the social and organisational function of "assistance" in these technical fields is still lacking. Therefore, the reflections in this paper may also provide some starting points for this debate.

Keywords: technical assistants; care setting; concept of assistance; need analysis; frame of reference; functionalities

1. Introduction

According to politicians' and scientists' visions of the future we are heading towards a "robot society" ([1]), at least in highly industrialised countries. This is particularly evident when looking at current national research programs or various countries' national action plans, in which the field of robotics is considered as an important future technology. The Dutch scientists Royakkers and van Est state, "the idea that in future robotics will play a central role in all spheres of our society" [2] (p. 5). They stress the fact that "automation is no longer limited to manufacturing processes" [2] (p. 1), but it is expected to be applied in many areas of society. Indeed, automation processes are increasingly found in all spheres of society, such as transportation, housekeeping and the care sector. Automation is expected to support manifold activities. "Assistive robotics" as a mayor field of technological innovation already plays an important role in public and scientific debates in many European countries. These debates are strongly connected with the challenges of ageing societies in the near future, where the lack of personnel can be compensated by "assistive robots".

As this article focuses on the daily working and living in inpatient care settings, the authors define "assistive robots" as technical devices, such as the TrinkTracker (an intelligent, sensor-equipped drinking assistant), fixed-based and mobile robots, bedside robots, and electrical hoists. These technologies perform physical tasks for the wellbeing of persons with or without disabilities. Besides, there are visionary technologies, such as care robots, eLegs, and walking assistive robots, which are still in research and development. As stated above, great expectations are placed on their future use in different nursing settings.

In the related debates, the keyword "assistance" is supposed to facilitate the breakthrough of these technologies, with "assistance" meaning the support, substitution, or supervision of (human) actions by robots in those different environments. Expectations of "assistance" play an important role

in the implementation model for technical assistance in the field of robotics, as suggested by Jasanoff and Kim [3].

When defining the character and functions of robots, it is crucial to make a distinction between technical "autonomy" and technical "assistance". While robots in factories have already reached a significant degree of technical autonomy (i.e., in the automotive industry), future developments in robotics should—at least in European countries (There remain fundamental differences in social perceptions of robots between European and Asian countries [2] (p. 1ff.) and [4]. Since the paper refers to the German debate, cultural differences of this debate will not be integrated)—be oriented towards the "assistance" of human action (This is specifically true for the health care and medical sectors. However, in mobility too, future visions of robots have raised controversial debate around whether machines/robots should act independently [5,6]).

The notion of technical "assistance", which plays an important role in visions of future health care systems, is strongly rooted in the concept of assistance in the professional structure of care work. With the expansion of medical premises since the beginning of the 19th century, the care profession has become more and more a profession of support and assistance in medical health care. In Germany, the "occupational field developed, up to that point, quite clearly along the boundary between academic medicine and its supportive, subordinate assistive occupations" (own translation) [7] (p. 376). The increasing separation of medicine and care (from a labour point of view) has strongly shaped the history of the care profession in Germany and in neighbouring countries. Today, this is reflected in the tension between individual "performance" and assistive activities in medical care. Furthermore, technical and medical standards have constantly advanced, e.g., in monitoring ventilators or thrombosis prophylaxis, to mention just two important fields of activity in inpatient care. In recent decades, the health care working environment has become increasingly technical, emphasising the assistive nature of the profession even more [8].

The meaning of "assistance" in care work can, however, also be understood in a completely different way. With regard to the care of ill and elderly people, assistance can be interpreted in its original meaning (Latin: *assistere,* "approach, join"), as getting closer to and "standing by" those who are in need of care and in a suffering stage of their lives. Care work, from this perspective, can be seen as an assistive practice, which is viewed, ideally, as empathetic companionship, which is aimed at reducing peoples' suffering and supporting the recovery process. These characteristics have become deeply rooted in the outsiders' perspective of the profession, and have developed into the central foundation of the profession's self-identity [9,10].

It would seem that the current debate around whether and how technologies/robots could and should support the care of elderly people refers to both notions of assistance [11,12]. Basically, the metaphor of assistance through technology has a positive connotation in this discourse and refers to the supportive effect on those in need of care and the elderly in their specific care contexts. The distinction between inpatient and ambulant care alone points to very significant differences in relation to these contexts [13]. Furthermore, when relating this to the original meaning of assistance in care activities as psychological and physical support in everyday life for people in need of care, the question of what role future assistive robots (e.g., robots that lift patients in and out of bed) should have remains unanswered. In this context, the umbrella term "assistive" technologies does not seem very constructive. In fact, it appears that the use of the term "assistance" is consciously linked to traditional metaphors of the care setting, including welfare, companionship, and empathetic support, in order to increase the social acceptability of these new technologies. In view of this assessment, the authors argue for reflecting on the metaphor of assistance in socio-technical systems and reviewing their relevance. This can only be achieved in the practical aspect of care if the frame and system of reference for the concept of "assistance" through technical systems is described, considered, and used by all involved.

Thus, the hypothesis of this article is that the functional character of socio-technical assistance will only emerge from the use of a defined system of reference. If this system is missing or unclear,

the "assistive" character of these technologies cannot be proven. This hypothesis will be considered and critically discussed in an empirical study within the exemplary context of the German inpatient care home. In the first section of the article, the notion of technical assistance is considered and conceptually scrutinised as to its relevance in the technical setting. In the second section, a research project on inpatient care for people with dementia is presented in summary, outlining specific expectations of technologies/robots with assistive functions. Finally, the results of the project will be presented and discussed, using examples. In conclusion, they lead to overarching questions regarding the conceptual requirements of future (robotic) technologies to ensure that they actually offer assistive functions.

2. Theoretical Background of "Assistance"

As set out above, "technical assistance" in many aspects of life has become a very popular issue in the public debate around technical innovation processes [14]. The conflict between autonomous and assistive technologies plays an important role here. This is particularly apparent in the technical field of robotics, where this conflict is explored from various angles, both from a practical and theoretic point of view [2,15,16]. While technical autonomy or automation of socio-technical systems has been promoted for decades in fields, such as aeronautics and space travel, or the production of goods, debate in the fields of mobility, medicine, or care has predominantly been focused on whether and how machines should interact with society [5,17]. Based on intelligent and co-operative information assistants, new forms of human-technology interactions are increasingly introduced, which can be distinguished by the following characteristics [5] (p. 186ff.):

- "Active" technology: technologies that do not run a standardised program, but rather independently choose a relevant program from a repertoire, as required (e.g., service robots which move freely and unobtrusively around the living environment, or internet search engines, etc.);
- "Interactive" technology: cybernetic machines with predetermined interactions, which do not have fixed stages to achieve that end, but rather based on an analysis of the situation (e.g., multi-agent systems within technical systems); and,
- "Intelligent" or "reflexive" technology: technologies where the interaction between humans and technical object is less a result of direct instruction and implementation, but where the implementation is increasingly based on quick establishment of data processing options (e.g., auto-pilot systems in vehicles).

Much like the term "information assistant", these expanded functions of the technical systems suggest the concept of "assistance", that is, active help through desired actions. This has led to further investigation into the tension between autonomous "doing" and "assisting" technologies. One of the most insightful examples of this contention is the use of surgical robots in medicine. "The idea of using industrial robots in the medical field had a great impact on the history of the first marketable surgical robots. Robodoc, a robot for use in hip operations, which was developed in California from the mid-1990's embodies this concept" [18] (p. 12). While robots usually operate according to the master-slave principle, Robodoc was meant to be different. The prototype, replicated by Caetano da Rosa in Germany, was designed to operate highly autonomous, with little human intervention. During the first implementation phase, Robodoc—defined by the Germany's Technical Inspection Association (Technischer Überwachungsverein, TÜV) as an "active medical product" [18] (p. 13)—actually performed its own set of activities, independently of humans. The technology was then transferred for use in the operating theatre in order to reach a level of technical precision in the milling process that "could not be achieved manually" [18] (p. 12). This gave rise to the idea of using industry experiences (e.g., technical precision) and transferring them into the field of medicine [19] (The relatively high numbers of accidents and the emotive media coverage of them did not, however, lead to the robots' removal from the operating theatre; rather the focus on the level of technical autonomy gave way to the idea of "assistance". Subsequent models of operation robots

"were reintroduced as teleoperated systems [. . .]. This new labelling for surgery (robot assisted surgery) made the new generations of surgical robots acceptable" [19] (p. 114) and [20].

This example highlights the aforementioned contention between "autonomous" and "assistive" technologies, which, over time, has shifted towards assistance. The concept of technical assistance suggests the possibility of technical interventions in medical activities. It defines an explicit hierarchy between technical and human spheres of activity, and refers to technologies that "support" and "clarify" human actions in the operating theatre. With regard to the conceptual meaning of "assistance", this example refers to the medical aspect, that is, technologies that contribute to medical-technical routine operations.

The central idea of "assistance" in the field of care, as addressed above, is rooted in the historical development of the profession, and is generally oriented towards the concept of medical premises and guidelines. This is reflected in the intense debate around the future structure of the care profession in Germany and elsewhere. The question here is whether and how the central idea of assistive activities will be carried forward into the professionalization of care, or whether it will be gradually abandoned. The idea of "assistance" should be considered and illustrated in the light of medically efficient health care provision, as is often claimed in the current debate about the integration of technical assistance systems in care. Technically supported intensive care, electromechanical lifting and carrying aids, as well as documentation supported by electronic data processing were already successfully introduced in inpatient care years ago, and have significant impact on professional care work. "The concept of assistance" here refers to the idea of "technical objects being regarded as extensions of medical care" (own translation) [21] (p. 107). From this perspective, the frame of reference for "assistance" predominantly refers to medical care provision and the improved efficiency of the care workforce [22].

This is the basic idea behind current developments in care robotics. The number of technical assistance systems for inpatient and home care is rapidly increasing. However, in terms of technical complexity, market share, and reach, they vary according to the area of use. This applies to "assistive" functions in medical and care provision, in particular to controlling and monitoring functions by "intelligent" technology. In home-based care, vital data (pulse, blood pressure, etc.) can be collected "through sensors (temperature, water and gas sensors) and transmitted to the care provider". In inpatient care facilities and hospitals as wells as in mobile care provision, technologies such as electrical hoists and emergency call systems have become standard. In addition, technologies such as mobility scooters provide "assistive" functions for the person in need of care. The majority of products and services in the health care sector are, however, still in the pre-market phase or have not yet entered the market. As a result, the products, with few exceptions, do not appear in common care situations (e.g., [23]).

"Assistive technologies" ("Assistive technology is any device or system that allows an individual to perform a task that they would otherwise be unable to do, or increases the ease and safety with which the task can be performed" [24]) have contributed to a high level of technology. However, empirical investigations have shown that technical "assistants" are often not oriented to the needs of the care setting, but much more to technical and economic requirements [13,25]. With regard to their assistive functions, it is largely unclear whether and how they serve the needs of carers and those that are in need of care. A closer look at these studies shows that the frame of reference for "assistive" technologies and their explicit uses need to be better identified and defined. The central question here is, how do these technologies relate to care activities? Who is the master and who assists? This touches on the fundamental question of how to describe "assistance" from an analytical perspective, in order to provide a development perspective for technologies in care settings.

In this article, these conceptual questions are investigated based on the re-evaluation of a two-year project, which will be outlined briefly in Section 3. The project's original aim was to ascertain the as yet not technically formulated requirements of technical "assistance" in the inpatient care setting. The needs for technical "assistive" systems, identified in this analysis, were to mark the beginning of a technology development project aimed at establishing a frame of reference for technical "assistance".

Assistance and reference systems were here considered together as a single entity, whose functionality was defined by the care setting.

Based on the project results, the authors have developed the hypothesis that the functional character of socio-technical assistance will only become apparent from the use of a defined system of reference. However, in most of the technical applications that are considered in the project, this was not the case. The re-evaluation of the study therefore dealt with the question, how to determine the assistive character of selected technologies. This question is analysed based on different results of the project. In the last chapter, the outcome of this analysis is discussed with regard to the research question of this article (Section 4).

3. Empirical Case Study: Technical "Assistance" for Inpatient Care of People with Dementia

The investigation of the two-year project "MOVEMENZ: a mobile and independent way of life for people with dementia" (The project was funded by the Federal Ministry of Education and Research, Further information about the project, see [26]) focused on surveying and analytically recording what stakeholders in a specific care setting perceive as meaningful technical "assistance" for maintaining mobility amongst people with dementia in inpatient care facilities. Consequently, the project investigated technical and non-technical "models" that would provide people with dementia the opportunities to once again independently go for walks, small shopping trips, or make visits within the communities around their care facilities. Whether or not this was possible, and what technical characteristics might be used were investigated through a comprehensive, qualitative needs analysis.

At the centre of this research was the issue to identify the needs of the users (people with dementia, professional carers, as well as relatives of those with dementia) for technical support in order to improve movement, which is a basic requirement within care activities. Against this background, the main areas of research in the pilot study focused on the following aspects:

- To what extent do people with dementia move around and outside inpatient care facilities?
- What demands are made by the various users of the technical object, in order to enable as much independent movement around and outside the facility?
- How much security can these technical objects provide, in order that people with dementia may move safely around the community?
- What expectations can be held of a community to ensure that people with dementia are supported within a "dementia-friendly" environment?

Thus, the research questions can be divided into two objectives, namely (a) the support/increase and maintenance of the mobility of people with dementia based on technical options; as well as (b) the integration of these options into the community. The research design was adapted to the everyday routines within inpatient care, as well as the community around the inpatient care facility.

3.1. Methodology

The research procedure was initiated by conducting a general observation of the activities and processes in an inpatient care facility. This followed the concept of participant observation, although the project team (information scientist, sociologist, Euclid scientist, philosopher, and engineer) with expertise in socio-scientific methods achieved merely a two-week period of observation. During this phase, four to five project team members were silent observers from morning until night in a care facility, and observed all of the stakeholders within the care setting in the establishment, including the interaction between those with dementia, their relatives, the professional carers, as well as volunteer carers. The observers sat everyday on chairs in one of the corridors. From there, they could see the dining area, the nurses' room, the stairs and the lift as well as the terrace. The scientific observation phase was part of a sociological methodological approach known as Grounded Theory, which included wide-ranging data collection as well as methodological observation. In line with the empirical approach

that "All is Data" [27], observations recorded individual stakeholders and their movements, events in the home, social frameworks, and interaction arrangements, as well as hierarchies and role distinctions.

The results from this phase—condensed into hypotheses—provided starting points for individual and group interviews by presenting possible expectations of "assistive" technologies. Individual interviews lead by two project members were conducted with the people with dementia and management, as well as representatives of the community. Group interviews in the form of focus groups were conducted separately with the professional carers, voluntary carers, and relatives of those with dementia (All interview partners, including the community representatives, were approached by the care home management team, and consent for those with dementia was provided by their relatives). In the semi-structured group and individual interviews, each of the interview partners first gave a description of themselves, which was then followed by questions as to the general need for assistance in care-giving. They concluded with a concrete discussion of the need for assistive technology from an individual and vocational perspective. All of the discussions from the individual and group interviews were captured by audio-recording and note-taking. Subsequently, all of the recordings have been pseudonomized, transcribed, and archived in order to prepare for a qualitative content analysis.

To provide some numbers that underpin the process: six individual half-hour to one-hour interviews were conducted with people with dementia, three individual one-hour interviews with management staff and two with representatives of the community; three two-and-a-half-hour exploratory focus groups consisted of six professional and seven voluntary caregivers, as well as six relatives (With one exception, the relatives who took part in the group interviews were not the relatives of the six people with dementia who were interviewed).

Finally, it emerged that it is not possible to clearly attribute functional uses to a technical "assistance" which has not yet been devised. Given that the entire care setting was geared towards providing the best possible care for the people with dementia, it was not possible to elicit a direct "use" from the implementation of potential (intelligent) technologies. However, often an indirect use resulted from the assistance, as other stakeholders in the arrangement made use of a technical support and, for example, gained more time for providing personal support and closeness. On this basis, the distinction between expectations of technical "assistance" appeared definitive. Therefore, the expectations that were expressed by people with dementia, their carers, and relatives of those with dementia will be covered separately below.

3.2. Re-Evaluation in the Light of "Assistance"

3.2.1. People with Dementia

The opportunity to interview people with dementia of the establishment within the framework of the survey was made full use of. It emerged, however, that these interviews could not be conducted according to the same guidelines for conducting and analysing interviews with care personnel or relatives, for example, but rather opportunities for interactive and comprehensive communication would have to be capitalised upon. As a result, the timings and subject matter of the communications opportunities with people with dementia were set by them, which led to a unique perspective. These discussions offered extremely valuable insight into individual experiences of dementia, life in the home and the perception of other people with dementia in inpatient care. Due to the methodology chosen, opportunities for eliciting expectations of assistance were limited. That said, statements regarding "assistance" could most certainly be gathered in a number of cases: two interview partners were unable to even suggest a technical device that could assist them in any manner. One further interview partner stated that he had no requirement for support through technology. The remaining interview partners were all able to call to mind a technical "assistance". They responded cautiously, but positively, to the suggestion of locating technologies, which would help them on outings, for example, by helping them to find their way back. A mobile phone for elderly people, with a display of pictures for contacts rather than numbers,

also prompted great interest. To summarize, three of the six individuals interviewed could not or would not name a type of technology that would assist them.

With regard to the question, whether and how technologies serve the needs of people with dementia, it can be constituted that the use of technologies for assistance in orientation and accompaniment was conceivable. However, the emphasis was emphatically on this more sensory technical "assistance". Besides this, there were also clues as to the use of technical "assistance" gleaned from the participatory observations. So, it can often be observed that users of established technical "assistants", such as wheelchairs and Zimmer frames, forgot to take off the brakes and therefore struggled to move the "assistant". Furthermore, the grips and exposed brake cables on the Zimmer frames and protruding wheel hubs where repeatedly disruptive and increased the risk of getting caught on them, or potentially falling. The reason for these difficulties could be a thorough lack of life experience and knowledge on the part of many product developers, who struggle to put themselves in the place of elderly people or those with dementia, and are unable to empathetically understand their "assistance" requirements. Moreover, during these observations, a certain lack of trust in the functionality of technical aids was noted. For example, a resident no longer used her mobile emergency button, as the first time she had used it, it had not worked due to being out of range. So, after a fall, she "had to slide on my back to get noticed" (as stated by a participant during participatory observations).

3.2.2. Professional Carers

Professional carers were also observed in their work routines and questioned about their expectations of possible technical "assistance". It is hardly surprising that their expectations directly related to occupational requirements for the care and support of elderly people in general, and for people with dementia, in particular. Managing those who have cognitive limitations presented particular demands on the day-to-day care that was required of care personnel. This involved carers in processes to which they had to bring qualified knowledge, as well as acute awareness. Intensive engagement with the effects of dementia and resolving challenging situations through biography building activities, for example, were rarely or never possible, as the demands of care predominantly focus on providing for the psychological and physical needs of elderly people, an issue that is not often covered enough in the care setting. From observations in the establishment and statements from carers, it is clear that the over-riding priority in daily care provision is to ensure care for the physical needs of the people with dementia, which satisfies all stakeholders in the care setting. This issue was focused on by the carers as a daily requirement. Indeed, according to the care workers, a number of possible technical "assistants" could help to ease the burden of this work. The shape and form this should take was at one point very vividly expressed: "not, I'll send in a robot and it will do what I say, but rather, I'll be there and have technical help" (care workers group interview transcript). Technical "assistance" here is not seen as autonomous activity in the care setting, but actually in the form of a desired and assistive "helper", to ease the burden of the carers' work. More specifically, the technical "assistance" related to the many routine care tasks, in the expectation of having more time for the person in need of inpatient care. In this scenario, one could be "completely different" (care workers group interview transcript), according to the care workers, because they would "be calmer, because we wouldn't have that pressure any more".

With regard to the question, whether and how technologies serve the needs of carers, it can be outlined that once the benefits of the "assistance" is seen, then the technology in everyday care activities itself is regarded positively. In addition, it can be concluded that "assistance" in care management from the point of view of the carers means actual support in daily routine tasks. This actual support can absolutely be interpreted as efficiency, but not as a means to speeding up the task process. Rather, the expectations were for technical assistance providing physical support, replacing time-consuming and routine activities, such as the regular drinks service.

3.2.3. Relatives

The results from the focus groups with relatives of those in need of care revealed that technical aids for easing the workload or providing support with work were equally positively viewed. In this sense, they incorporated the views of those in need of care, as well as those of the carers. First and foremost was the desire to represent their own relatives and to help secure optimum conditions for them. The relatives also emphasised to a certain extent that the availability of technical "assistance" was often limited, and that this often went unrecognized. They saw here a gap between the social feedback from their experiences and the technology developers. The group interviews with the relatives confirmed the statements expressed above, namely that the functions of the technical systems accredited to the developers were positively received, such as a Zimmer frame's constant prop when walking, and the additional security when sitting, standing, or resting has been improved by the installation of lockable brakes. However, the argument that technological developments often ignore real contextual requirements was discussed. In the imagined care facility, for example, they predicted that the use of advanced Zimmer frames would be impossible due to restricted space as well as reduced capability amongst users. One relative referred to this: "It must not be complicated—my mother can't even adjust the backrest on her own anymore without help, and when I tell her how to do it, she can't remember the following day . . . " (Relatives' group interview transcript).

With regard to the re-evaluation, this selection of examples highlights that when it comes to the development of technical "assistants" in care, the technical functionality and the purpose of use is prioritised. Furthermore, if "assistive" functions were identified, then these are always related to the actual needs of the various users as well as the context of use. From the point of view of all those involved in the care setting, these needs of "assistance" are embedded in an operational framework that has to be carefully determined.

3.2.4. Overall Empirical Results from the Study

In the light of re-evaluating the study, four overall results have been elaborated:

Firstly, the majority of the carers interviewed in the study considered "active" and "interactive" technologies, such as the care trolley, to constitute "assistants". The situation was different when it came to the vision of a Zimmer frame equipped with sensors that count the steps or "advise" the user to walk upright. In this case, the missing frame of reference that defines the assistive uses of these technologies led to controversial discussions. These discussions showed that advanced technologies are no longer perceived as "assistants", when they serve multiple purposes.

Secondly, as shown above the application in daily life does not sufficiently include the (a) social heterogeneity of the users; and the (b) preconditions of the users: age, fragility, multitude of insecurities and anxieties, their respect for rules and regulations, and their ability to adapt technicised world. Technology development in the field of care very often does not—or only inadequately—take into account the specific social context, and thus lacks a frame of reference for the "assistive" functions of the technologies and their application.

Thirdly, once, the "assistive" function of a technology is defined and the benefits for the users are obvious, the acceptance of technologies is relatively high. Technical assistants used in the care setting are accepted on the basis that they relieve the burden of work, simplify work, and are practical. This is specifically true for the caregivers in the sample. But also the other participants of the care setting have shown a great degree of open-mindedness with respect to technical support. This also applies to advanced technologies such as automated systems or even robotics as a hypothesis.

Fourthly, new technologies should be discussed based on sensible needs analyses which focus on the management and functions of the technical "assistance" systems. The above-mentioned contentions between "autonomous" and "assistive" technologies in care settings must be identified and solved in order to respond to the differing expectations of the users/stakeholders. As the empirical setting show, social (and ethical) aspects of the expectations in our case setting should be defined and discussed carefully. There are significant differences between the social groups with regard to their specific needs

and expectations. Specifically, with regard to the dynamics of technical innovations, these expectations should be taken into account.

4. Assistant without Master? Conclusions on Assistive Robotics in Health Care

This paper is based on a re-evaluation of the results of a previous project, which have also motivated the presented study. The expectation of technology development in people with dementia in inpatient care was to develop technical "assistance", robots included. The examples illustrated here point to some key aspects which may contribute to clarifying the concept of "assistance" in robotics development. The use of assistive robots in health care is already widely discussed in scientific and public debate, particularly with regard to current and future personnel shortages in the care sector. However, an analytical understanding of how technologies could offer "assistance" in the care settings lag behind. As was outlined at the beginning of this article, "assistance" should always be considered in a frame of reference determined by the area of activity. Thus, from the conceptual point of view, a frame of reference must be identified in order to understand and develop the functional meaning of "assistance". This refers both to the social and technical context of new innovations. Assistance and its frame of reference, as well as medical guidelines for care and/or professional day-to-day care provision from the point of view of those in need of care, have an effect on each other, which needs to be established. Thus, we can only speak of "assistance" within a framework that includes all of the factors, and where assistive functions are related to a specific field of activity.

If the concept of "assistance" is understood in its original sense of helping, accompanying, and supporting and these ideas are translated into the concept of technical "assistance" as a subordinate but important function in the care of people, there is great potential for social innovations. It is irrelevant what form these technical "assistants" take. If, however, the idea of advanced technology development is at the forefront, the concept of "assistance" loses importance and gives rise to reasonable doubt as to the assistive functions of technology in future care settings.

Starting from the hypothesis that the functional character of socio-technical assistance will only emerge from the use of a defined system of reference the results of the re-evaluation show that technical assistance very often is not defined to its reference system. This is particularly the case if the technologies are used as "assistants". Thus, "technical assistance" is seen as just that when it eases the burden of carrying out day-to-day care work. The frames of reference must be investigated for every care setting and developed in collaboration with all of the stakeholders, and it should be defined carefully with regard to its functions. This will probably reduce the variety of applications of technical systems and increase the "assistive" use of technologies. This seems even more important when technologies become more complex, as in the case of robots. The relatedness between "assistive" functions and the frame of reference is essential for the convergence of technology as an assistant. This relatedness theoretically and empirically have to be taken into account in further technological innovation on robotics in health care.

Author Contributions: The central research question of the MOVEMENZ-project was whether and how to integrate social demands into the innovation process, with all stakeholders in the care setting being involved. The empirical work was based on different methods and practices developed by the MOVEMENZ team. The hypothesis derived from this project with regard to the need of a frame of reference for technical "assistance" was developed by Bettina-Johanna Krings in the final stage of the project. Together with Nora Weinberger, this hypothesis was conceptualised based on literature and a re-evaluation of the empirical results of the project. The theoretical work was carried out by, data analysis by Nora Weinberger. Both authors compiled the results and wrote the paper. Both authors have read and approved the final manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

References

1.　Van Est, R.; Kool, L. (Eds.) *Working on the Robot Society: Visions and Insights from Science Concerning the Relationship between Technology and Employment*; Rathenau Instituut: The Hague, The Netherlands, 2015.

2.　Royakkers, L.; van Est, R. *Just Ordinary Robots. Automation from Love to War*; Taylor & Francis Group: London, UK; New York, NY, USA, 2016.

3.　Jasanoff, S.; Kim, S.H. Containing the atom: Sociotechnical imaginaries and nuclear power in the United States and South Korea. *Minerva* **2009**, *47*, 119–146. [CrossRef]

4.　Moniz, A.; Okuwada, K. *Technology Assessment in Japan and Europe*; KIT Scientific Publishing: Karlsruhe, Germany, 2016.

5.　Rammert, W.; Schulz-Schäfer, I. *Können Maschinen Handeln? Soziologische Beiträge zum Verhältnis von Mensch und Technik*; Campus: Frankfurt/Main, Germany, 2002. (In German)

6.　European Robotics Technology Platform (EUROP). *Robotic Visions to 2020 and Beyond: The research Strategic Agenda for Robotics in Europe*; European Robotics Technology Platform: Brussels, Belgium, 2009.

7.　Wetterer, A. *Arbeitsteilung und Geschlechterkonstruktion—Gender at Work in Theoretischer und Historischer Perspektive*; UVK Verlagsgesellschaft: Konstanz, Germany, 2002. (In German)

8.　Hülsken-Giesler, M. *Der Zugang zum Anderen. Zur Theoretischen Rekonstruktion von Professionalisierungsstrategien Pflegerischen Handelns im Spannungsfeld von Mimesis und Maschinenlogik*; Universitätsverlag: Osnabrück, Germany, 2008. (In German)

9.　Abel-Smith, B. *A History of the Nursing Profession*; Heinemann: London, UK, 1960.

10.　Abdellah, F.G.; Beland, I.; Martin, A.; Matheney, R. *Patient-Centered Approach to Nursing*; Macmillan Company: New York, NY, USA, 1960.

11.　Butter, M.; Rensa, A.; van Boxel, J.; Kalisingh, S.; Schoone, M.; Leis, M. *Robotics for Healthcare (Final Report)*; DG Information Society; European Commission: Brussels, Belgium, 2008.

12.　Broekens, J.; Heeringk, M.; Rosendal, H. Assistive social robots in elderly care: A review. *Gerontology* **2009**, *8*, 94–103. [CrossRef]

13.　Hülsken-Giesler, M.; Krings, B.-J. Technik und Pflege in einer Gesellschaft des langen Lebens—Einführung in den Schwerpunkt. *Technikfolgenabschätzung Theor. Prax.* **2015**, *24*, 4–10. (In German)

14.　Eglash, R. Broken metaphor. The master-slave analogy in technical literature. *Technol. Cult.* **2001**, *48*, 360–369. [CrossRef]

15.　Decker, M. Robotik. In *Handbuch Bioethik*; Sturma, D., Heinrichs, B., Eds.; J.B. Metzler: Stuttgart/Weimar, Germany, 2015; pp. 373–378. (In German)

16.　Pransky, J. Service robots: How should we define them? *Serv. Robot Int. J.* **1996**, *2*, 4–5.

17.　Rammert, W. Technik in Aktion. Verteiltes Handeln in sozio-technischen Konstellationen. In *Autonome Maschinen—Perspektiven Einer Neuen Technikgeneration*; Christaller, T., Wehner, J., Eds.; Westdeutscher: Wiesbaden, Germany, 2002. (In German)

18.　Da Rosa, C.C. *Operationsroboter in Aktion. Kontroverse Innovationen in der Medizintechnik*; Transkript: Bielefeld, Germany, 2013. (In German)

19.　Maria Joao, M.; Krings, B.-J. Robots in Surgery: Transformation of Work in the Operation Room. In *Practices of Innovation and Responsibility: Insights from Methods, Governance and Action*; Bowman, D., Dijkstra, A., Fautz, C., Guivant, J., Konrad, K., van Lente, H., Woll, S., Eds.; IOS Press: Amsterdam, The Netherlands, 2015.

20.　Speich, J.E.; Rosen, J. *Medical Robots. Encyclopedia of Biomaterials and Biomedical Engineering*; Marvel Dekker: New York, NY, USA, 2004.

21.　Hülsken-Giesler, M. Pflege und Technik—Annäherung an ein spannungsreiches Verhältnis. Zum gegenwärtigen Stand der internationalen Diskussion. *Teil Pflege* **2007**, *20*, 103–112. (In German)

22.　Pfeiffer, S. *Arbeitsvermögen. Ein Schlüssel zur Analyse (Reflexiver) Informatisierung*; Verlag Sozialwissenschaften: Wiesbaden, Germany, 2004. (In German)

23.　Rachmann, A.; Maucher, I.; Schöler, B.; Hewing, M. Benutzerzentriertes Service Engineering am Beispiel einer Telemonitoring-Dienstleistung. In *Mit AAL-Dienstleistungen Altern. Nutzerbedarfsanalysen im Kontext des Ambient Assisted Living*; Bieber, D., Schwarz, K., Eds.; Institut f. Sozialforsch. u. Sozialwirtsch: Saarbrücken, Germany, 2011; pp. 197–218. (In German)

24.　Royal Commission on Long Term Care. *With Respect to Old Age: Long Term Care—Rights and Responsibilities*; TSO—The Stationery Office: London, UK, 1999.

25. Elsbernd, A.; Lehmeyer, S.; Schillingen, U. Pflege und Technik—Herausforderungen an ein interdisziplinäres Forschungsfeld. *Pflege Gesellschaft* **2015**, *20*, 67–76. (In German)
26. Weinberger, N. Institute for Technology Assessment and Systems Analysis (ITAS). Available online: http://www.itas.kit.edu/english/projects_deck14_movemenz.php (accessed on 9 January 2018).
27. Glaser, B.G. All is Data. *Grounded Theory Rev.* **2007**, *6*, 1–22.