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Imagining and tinkering with assistive robotics in care for the disabled

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Abstract: The media and political-managerial levels focus on the opportunities to re-perform the Scandinavian welfare states through digitization. Especially in Denmark, this trend is prominent. Welfare technology is a Scandinavian notion used to point at assistive technologies intending to support the elderly, the disabled and care providers. Feeding assistive robotics (FAR) is a welfare technology relevant to citizens with no or low function in their arms. Despite national dissemination strategies, it proves difficult to recruit suitable users. There have been many promises for the potential of assistive robotics including more cost-efficient healthcare delivery, engaged patients and connected care providers. However, the realities of enacting assistive robotics, whether as patients or care providers, can be complicated in ways often unanticipated by government agencies and technology developers. This study discusses governmental agencies' and technology developers' visions with regard to what robotics may do and argues that these visions intertwine with affected stakeholders' organizing of their worlds. On this founding, the article discusses the resulting tinkering during implementation. The study exemplifies and demonstrates how ethnography can be used as an important method in Human Robot Interaction (HRI) research. The Actor Network Theory idea of 'follow the actor' inspired the study that took place as multi-sited ethnography at different locations in Denmark and Sweden. Based on desk research, observation of meals and interviews the study examines sociotechnical imaginaries and their practical and ethical implications. Human and FAR interaction demands engagement, sustained patience and understanding of the citizen's particular body, identity and situation. The article contributes to the HRI literature by providing detailed empirical analysis based on an ethnographic study where political strategies, technology developers' assumptions and affected stakeholders' everyday hassles are in focus at the same time.

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1 Introduction

Based on an ethnographic study this article explores the relation between the health political vision of assistive robotics and ongoing transformation in care for the disabled. Citizens with low or no function in their arms are currently obvious candidates to use feeding assistive robotics (FAR). The Danish strategy for implementation of digital solutions and welfare technologies issued by the Danish government, the regions and the Danish municipalities in 2013 [1] states FAR may both enhance vulnerable citizens' self-reliance and ameliorate the care providers' working environment. The notion of welfare technology point at assistive technologies intending to support the elderly, the disabled and care providers (CPs). As part of this, FAR is endorsed based on a business case carried out in 2011-2013 [2]. It proves difficult to recruit suitable citizens, and to sustain use over an extended period [3, 4]. As early as in 1936, Charlie Chaplin envisioned mechanized feeding. In 'Modern Times' his little vagabond struggles to survive in the modern, industrialized world during the depression and is hired at a factory. As part of this imaginary, he is fed his lunch by crude machinery and, thus, Chaplin showed, according to him, the horrible conditions of efficient modern industrialization. The use of FAR in care for the disabled is obviously much less sinister, but it still presents a complication of the relations between the technology, users, and CPs. Arguably, in order to ensure ethical and responsible development of assistive robotics, there appears to be too much distance between policy makers, technology developers and affected stakeholders. This has likely to do with conflicting value systems that undermine the full use of the technology and hinder unfolding of potentials. In order to ensure ethical and responsible development of robotics, technology developers and affected stakeholders need to communicate more. In a comprehensive and thought-provoking review of ten pivotal ethnographic studies on the nature of the task of feeding dependent bodies [5] two consistently emerging tropes among CPs 'feeding as task' and 'feeding

as relationship' are identified. Despite the fact that the task of feeding dependent bodies constitutes a common activity in many health care settings, it enjoys surprisingly little interest from researchers and practitioners. During the last decades, it appears that manual feeding is eliminated from nurses' responsibilities and relegated to non-professional staff because it is increasingly seen as 'an efficiency task' and not a valued opportunity of 'the art of nursing'. It has, in other words, become low status and, thus, it is now an obvious candidate for being supported by robotics.

Some groups have made compelling arguments and presented digital health technologies and robotics in a favorable light as the healthcare of the future [6]. There have been many promises for the potentials of these technologies including more cost-efficient healthcare delivery, engaged patients and connected health professionals [7]. Yet, the realities of enacting robotics, whether as patients or CPs, can be messy, uncertain and complicated in ways often unanticipated by policy makers, technology developers, and other advocates [8]. As a response to this, the research questions of this study are; 1. How do various stakeholders actively organize their worlds of action with assistive robotics? 2. How do visions and practices among government agencies, technology developers, CPs and users entangle in ongoing transformation in care for the disabled? In order to discuss this I draw particularly on Mol, Moser and Pols [9], and Jasanoff and Kim [10], and I present a case study of implementation of 'Bestic' - the second generation of FAR. An example of the first generation FAR is the British 'Neater Eater Robotics', which has been claimed to be noisy and take up space in the environment of its user. In this sense, it prescribes the user scenario and allots new tasks and responsibilities to the CPs [11]. Recently, second generation of FAR, the Swedish 'Bestic', has appeared on the market. Bestic is an electric spoon that is adapted to the user and quietly lifts the food up to the mouth. It is designed to help people who cannot use their arms when they eat. The user controls it with a button placed strategically in relation to the user's impairment. It can, for instance, be on the table where it can be controlled with the elbow. All meals can be eaten with Bestic. Bestic scrapes the bottom of the spoon on the plate, so the user does not waste. It folds easily together after the meal. Moreover, Bestic can easily be carried around in a handy carrying backpack. A fully charged battery can last a full day. In relation to the Neater-Eater robotics, Bestic is more mobile, leaner, and technologically advanced. In addition, it appears easier to manage for users and CPs. See Figure 1. This study highlights the visions, ethics and performed practices of government agencies, technology developers, and affected stakeholders in relation to implementation of Bestic.

Fig. 1. Pictures of Bestic 1 (left) and 2 (right).

2 Methods

2.1 Analytic inspiration and literature

Using material semiotics [11–13] as an analytic resource, this study draws on the Actor Network Theory idea of 'follow the actor' throughout the empirical work [14]. The analysis combines the notions of sociotechnical imaginaries and care as tinkering. The sociotechnical imaginaries in relation to FAR are scrutinized [15, 16] in combination with the attunement and tinkering involved in adapting and forming new routines in relation to the implementation of Bestic. To use these two notions in combination is an analytical point of this paper that tells us about the political visions of health robotics and, at the same time, about the implied transformations in practice among affected stakeholders, i.e. users and CPs.

The notion of sociotechnical imaginaries draws on science and technology studies (STS). This notion is defined as: '[The] collectively held, institutionally stabilized and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through and supportive of, advances in science and technology' [17, p. 153]. The naming of the concept of sociotechnical imaginaries indicates links to both political theory [18] as well as STS. The compound nature of this concept is intentional as it is an attempt to overcome the, arguably, excessive focus on the individual scientist and particularities of locality. Focusing on

the sociotechnical imaginaries involved in FAR, invites the reader to dive into the relationship between imaginary in terms of applications of science and technology and the practical effects of this imaginary in mundane everyday life. Importantly, the notion of 'sociotechnical imaginaries' differ from 'discourse' or 'master narrative' by focusing, not predominantly on language, but specifically also on the relation between anticipations of the future and performed relations. Moreover, sociotechnical imaginaries differ from the notion of 'culture' by being less monolithic and by sociotechnical imaginaries being both contested and conflictual propositions. Various actors hold different sociotechnical imaginaries that shift when enacted in practice.

Sociotechnical imaginaries are interesting in relation to health care robotics because it suggests analyses that combines politics and interpersonal action and links structure and agency by putting together prescribed futures and practices that people aim to obtain or believe they ought to obtain. Therefore, I analyze sociotechnical imaginaries in regards to FAR as illustrations of ongoing re-imagination and re-performance of the Danish state and its institutions that have tangible implications for the everyday enactment of care for vulnerable citizens [16]. The sociotechnical imaginaries such as 'Denmark as a digital pioneer', 'Danes as world champions in digitalization currently penetrate the political-administrative landscape and discourses in the media [19]. Denmark has traditionally had an agricultural economy. In present times, focus is on the opportunities for Denmark to re-perform itself by way of digitization. Thus, every government funded financial and economic stimulus package leads more money into digitization, automation and shared economy. In order to promote this development, the Danish prime minister is currently the chairperson for the national Disruption Council in which leading officials and experts work to find potentials to use digitization in an increasing number of areas. As part of this imaginary four highly profiled welfare technologies are implemented on a national scale (FAR being one of them) to provide a modern care-infrastructure characterized by increased independence for users, better work environment for CPs and reduced costs [20, 21].

These strategic and political acts are elements in a sociotechnical imaginary on a national scale, but such imaginaries are not only ideals and intentions. They also engrain in practice on an everyday level when CPs and citizens enact the sociotechnical imaginaries in using FAR. By combining analyses of political level documents with observation and interviews with technology developers and affected stakeholders an analysis of imaginaries is in line with the ambitions of Latour of analyzing complex phenomena by both localizing the global and intangible and, likewise, globalizing the local by analyzing how particularities are linked to wider phenomena [22]. Moreover, an analytic focus on sociotechnical imaginaries not only puts focus on the here and now, but also includes the desirable futures and values towards which actors orient themselves. In that sense, sociotechnical imaginaries are performed value systems.

When seeking to understand care innovation in relation to the sociotechnical imaginaries of assistive robotics it is crucial to situate care workers' conduct not just in their relations with users/citizens, but also in all their relations. Focus must be broader than the discursive dimension; one must analyze the care workers values and how they practically organize their world of work through symbolic meanings and categorizations such as 'empathy', 'communication' or 'the body'. It is necessary to study their agency and modes of ordering [23, 24]. A number of leading researchers [9] propose that care work is a matter of attentive tinkering with arrangements of people and technical aids. Winance [25] has demonstrated the tinkering and experimenting involved in adapting wheelchairs for the disabled. Tinkering, she argues, is to shape and arrange humans and non-humans in ways that suit them. It is a matter of arranging people and technical aids and continually to change tiny details to ensure that the collaboration between humans and non-humans work optimally. Thus, according to Winance, care is not merely something a CP gives to a patient, an elderly or a disabled person. Rather, care is continuous experimenting with people and things. It is to shape, arrange and rearrange details. In this perspective, we are all both subjects and objects of care. This is interesting because it opens up the possibility that technology, not only constitute an aid (or hindrance) to the user, but also to the care worker.

Therefore, the notion of tinkering has comprehensive implications for how to analyze the relation between assistive robotics, technology developers, users and CPs. Instead of casting care and technology as opposed, as respectively 'warm' and 'cold', technology is just another part of care work that leads to movement. Technology simply adds to what is already there. Certain arrangements of humans and technical aids make competent users and others make incompetent users [26]. In this way, material semioticists [9] seek to rethink and reframe care and technology together. In other words, material semiotics seek to disturb, complicate and contribute to the care-technology relation. What do CPs, for instance, do with the technology they face? Tinkering is a crucial notion that helps focus on care workers active organizing of their participation in care innovation.

Another important material semiotic work problematizes the assumption that care work can be measured and defined outside the practice of caring [27]. This obviously refers to discussions in regards to accountability and evidence-based practice. I find that a national strategy and rollout plan for the use of FAR in 98 Danish municipalities exemplifies an accountability process in the sense that it embraces centrally defined assumptions of best practice. The key in relation to this analysis is that the use of FAR is defined outside the practice of caring and as such forms a sociotechnical imaginary of a golden standard. However, according to material semiotics there is no singular, shared form of care. Instead, they propose, we should try to understand 'multiple care' as this performs in different sites of care. In addition, they argue that improvement of care, in general terms, is not something that has to pass a golden standard or an outside judgement. Rather it is something that takes place as attuned attentiveness as part of care itself.

2.2 Why FAR?

This study focuses on FAR and particularly Bestic for a number of reasons. Firstly, due to the often high and widely expressed potential that is notably still unprecedented. Secondly, because the intimacy and the close human-machine encounter makes FAR an interesting case in relation to the issue of human-machine proximity as well as health robotics and future imaginaries more broadly. Thirdly, because of the paradox that FAR, in many observers' eyes, is immediately controversial, yet still broadly endorsed and implemented by the authorities.

2.3 Design of the case study

The empirical study comprises qualitative data in relation to implementation of FAR. The study is designed as a multi-sited case study at different locations in Denmark and Sweden [28, 29]. The notion of 'multi-sited' [30] designates that ethnographers increasingly move from conventional single-site location, contextualized by macro-constructions of a larger social order, such as capitalism, to multiple sites of observation and participation that crosscut dichotomies such as the local and the global, the lifeworld and the system. Resulting ethnographies are therefore both in and out of the world system. The appearance of multi-sited ethnography is located within new spheres of interdisciplinary work including, for instance, STS, cultural studies and media studies. By taking advantage of multi-sited ethnography, this study examines the relationship between politicians and technology developers' sociotechnical imaginaries as well as the practical use and implications of robotics. The methodological combination of following the actor and multi-sited ethnography made it possible to untangle a network of pivotal actors with regard to the application of FAR in a Danish rural municipality. The data collection consisted of desk research, observations and interviews. Alongside reading of public documents, the data collection consisted overall of the observation of three meals and 16 semi-structured interviews that took between 30 and 120 minutes. Two interview guides were developed for technology developers and affected stakeholders. The interviews were recorded on a Dictaphone and a research assistant transcribed all of them verbatim.

2.4 Government

First, I interviewed an official in Local Government Denmark (LGDK), the association of municipalities about the making and faith of LGDK's national welfare technology plan encompassing a plan for financial savings (2014-2017) [31]. LGDK systematically monitors implementation of welfare technologies in Danish municipalities. Internationally, it is extraordinary that Danish policymakers launch and control national rollout plans of assistive robotics. This likely has to do with the fact that Denmark is a small country and that Denmark has a universal health care system. Although Sweden also has a universal welfare system, they have no centrally controlled dissemination of welfare technology. In the Netherlands, they would never launch such a strategy due to a much more privatized and negotiated health care system.

2.5 Technology developers

The interview at LGDK was followed by an interview with Careware, the distributor of Bestic in Denmark and with the CEO and the developing engineer in Camanio Care, Stockholm (the producer of Bestic). The former interview was about the functionality of Bestic and the dissemination in all Danish municipalities. The latter interviews were about the design process and ethical considerations with regard to the practical use of Bestic. I first questioned the CEO and the developing engineer about the technical components and functions of Bestic. For example, one question was, why was Bestic developed? In addition, I asked about the design process and evaluations of techno-

logical readiness. Lastly, I asked about challenges, any unintended effects, and relations to policy makers and users. The technology developers' assumptions are less emphasized in the following analysis than the governments', the CPs', and the users'. This is because access to technology developers appeared to be difficult, and because more written material was found about the government agency perspective.

2.6 Care providers

I interviewed the head occupational therapist in a rural municipality about the local assistive robotics strategy. This gave access to a number of very interesting informants, i.e. directly affected stakeholders. Overall, eight CPs were interviewed - four CPs at home institutions and four CPs at day care centers. Six of these interviewees are formally educated as pedagogues. Two are care assistants. In this article, I, consequently, denominate all eight people 'CPs'. All mentioned names are pseudonyms in order to anonymize the informants' identities. I interviewed users and CPs in close relation to the observation of meals. I will expand more on the precise questions and method in the next section.

2.7 Observation of meals followed by interviews with users and care providers

The two users I observed and interviewed both have difficulty speaking, and since it is difficult to understand, I observed meals in combination with interviews with users and their CPs. The CPs could then immediately make sense of difficult sentences. The users both suffer from cerebral palsy. I observed Tonni eat with Bestic three times (three meals). I started my investigations in the day care center by interviewing Tonni and the occupational therapist together. Later, in relation to the observation I interviewed Tonni and three day care center CPs directly involved in Tonni's daily care. Furthermore, I observed Tonni eat his dinner in the home institution followed by an interview with Tonni and two home-institution CPs. Tonni was enthused by the autonomy the FAR gave him. Later, I got access to Tanja. Recently, she stopped using Bestic due to multiple problems. I found this span of experiences with Bestic interesting. First, I interviewed her and a CP at the day care center. Later, I visited Tanja at the home-institution where I also interviewed two CPs supporting her specifically about the decision to stop using Bestic.

In all of the mentioned interviews with the directly affected stakeholders, the functional and ethical issues, everyday use in practice, implementation and emerging routines were in focus. These interviews worked as further inquiry into the observations of the preparation, context and process of the meal. I asked about the FAR-meal as a worksite compared to the pre-robotics meal worksite. Thus, the focus was on: 1. Routines and changes of routines in relation to implementation of Bestic, 2. Any observed changes in the CP-user relationship, 3. Quality delivered to and experienced by the user. Apart from the meals with Bestic, I also observed traditional feeding meals. Two meals were at the day care center and one at Tonni's home institution. During the meals, I was sitting right in front of Tonni with a notebook and a cellphone. In advance, I had obtained permission to take photos and make small video recordings. Having in mind that eating is quite intimate; this set-up was perhaps excessive. It was supposed to support memory, analysis and detailed communication. From this position, I could observe and inquire into all aspects of the meal. I presented myself as a robotics researcher and all of my informants explicitly accepted my attendance and the set-up. The users and CPs unanimously reported they found it important to communicate their experiences. The interest during observation focused on the performance of the robotics, the CP's organization of the meal and the user's interaction with FAR. I was interested in what they did and what they talked about during the meal, how they treated the food, and how long a meal took. Before, during and after the meal I observed and noted as much as possible. I also talked with the users and the CPs to elaborate as much as I could on the observations.

I coded all the interviews by a simple read/re-read and highlighter approach along two themes: 1. CPs tasks and change of tasks in relation to the robotics meal, 2. Changes in the relation between CPs and users due to robotics. Then, I analyzed this material with the research questions in mind.

I found much inspiration in the notions of sociotechnical imaginaries and tinkering. By drawing analytically on Jasanoff and Kim and Mol, Moser and Pols, I followed the FAR around in various sites in order to explore how sociotechnical imaginaries on behalf of the government and technology developers have effects and interfere with implementation of Bestic. Desk research and interviewing of officials, the Camanio Care CEO and developing engineer relates in particular to mapping of sociotechnical imaginaries, whereas interviewing and observation of CPs and users relates in particular to tinkering and the implicated transformations in everyday practice of Bestic.

This method section does not intend to position these findings as universally generalizable, nor does it intend to confound assistive robotics in general with the specificities of FAR/Bestic. Currently, health care robotics, consist of a row of different set-ups and affordances [32]. My interest comes out of curiosity in relation to an ongoing national strategic implementation of welfare technology. Thus, my aim is to criticize and contribute to continued responsible, ethical and solid implementation of assistive robotics.

3 Results

A complex case study always has multiple facets, and focusing on any of these will necessarily foreground some aspects and marginalize others [33]. My approach to 'results' is to present a case of multiple intersecting sociotechnical imaginaries. The master narrative of 'Danes as world champions in technology' is evident throughout the case, and it's relevant point of origin is different government agencies. In 2014 LGDK established the 'Center for Welfare Technology', an office with the task to continuously produce outcome measures for the dissemination of robust welfare technology in the municipalities based on convincing business cases. Thus, they figured out the following welfare technologies support quality, savings and flexibility. It is decided to implement all of them on a big scale: 1. Patient lifting technologies, 2. Wash toilets, 3. FAR and 4. Better use of assistive technologies.

An example of a user of one of these welfare technologies is Tonni who is 32 years old and suffers from cerebral palsy. When I meet him, he had used Bestic for 14 months. He lives at a home-institution with five other challenged citizens. He gets manual help with eating in the mornings. He brings FAR in a knapsack from the home-institution to the day care center where he is part of a music group. At the day care center, he enjoys his lunch with Bestic. He also eats his dinner with FAR at home, but there are obstacles. In contrast, Tanja recently stopped using FAR. She also used it during lunch at the day care center - and it worked well. However, Tanja and the CPs in her home institution had trouble. Tanja used Bestic for three daily meals during five months before stopping. When she ate with FAR she spent 15 minutes more per meal, compared to eating manually with a CP. This was particularly an obstacle in the mornings. These two examples (Tonni and Tanja) point to the possibility that users and CPs appropriate Bestic differently due to situation, identity and bodies.

Technology developers face problems in implementing FAR in practice. '*It often stops with the CPs', they say. 'They need to change routines in relation to the meal*'. They assume this is mainly due to lack of knowledge on robotics and because there is no training in use of assistive robotics in formal basic education. Moreover, there is lack of professional courses for CPs. Technology developers particularly point at a need for training and continuing education in relation to problems arising during a meal. An initial assessment is that the key hindrance in implementing FAR is a lack of competencies and training. I will now revisit the above-mentioned in relation to analysis of sociotechnical imaginaries and show how various imaginaries intersect and are misaligned. I am interested in understanding more of what various imaginaries seek, foster and hope for and what is seen as 'good' and 'bad'. Moreover, I am interested in what happens when different performances of 'good' meet.

3.1 The users – 'Love of technology' as a sociotechnical imaginary

Tonni's use of FAR is not as smooth as it initially appears. A detailed scrutiny of a Bestic-meal illustrates both the empowerment and the daily hassles that comes with FAR. I will argue that the sociotechnical imaginary of being a leading nation in digitization intertwines with daily tinkering and footwork to make the robotics workable and meaningful.

The CP prepares Tonni's lunch by mounting a table on the wheelchair, then she unpacks the FAR from Tonni's knapsack and mounts it on this table. Attentively, she spreads chicken and rice from a box, Tonni has brought from home, on the plate. Tonni carefully activates the blue panel on the table with his left elbow. The Bestic-spoon and arm immediately goes down for food, but unfortunately, it shovels the food over the edge of the plate. It ends on the table. The CP smoothly lifts the food back with a spoon, and consequently gently adjusts the position of Bestic. As Tonni continues, the arm and spoon now swing too far out. Now, the spoon pushes Tonni's cheek and due to his lack of muscle control, Tonni has difficulties snapping the spoonful and getting it into his mouth. Again, the CP rearranges the position of Bestic slightly. The three CPs sit at an adjacent table. They have their lunch. Before Bestic, one of the CPs would sit completely with Tonni and manually feed him. Now, the three of them sit together and talk (now more or less a lunchbreak). However, one of them now and then needs to help Tonni. This provides them with flexibility and overview, they say. One

of the CPs, June, is particularly fond of Bestic. She appears to be Tonni's favorite manual eating partner. She thinks Bestic not only cares for Tonni, but also for her. Feeding another human being manually can be demanding. The CPs tell about Tonni's manual eating partner hierarchy. Tonni prefers to eat with June, but he prefers the FAR to Nete, they say. Tonni does not want to eat with Helge at all, who is thus in the last place, and Bestic is rated as the second best eating partner. Tonni has given Bestic a name, 'Yvonne' – a woman's name. Thus, three 'women' top Tonni's eating partner hierarchy. A factor indicating affectionate, perhaps even erotic, connection to the food provider and the situation of eating. This, observation, I believe, illustrates both emerging opportunities and ongoing transformations in care work. Human services now compares with robotic assistance and CPs may to some extent exchange with robotics and emotional attachment even seems to take place between body and machine. This interferes to some degree with the CPs' imaginaries of care as a question of gathering, community, empathy and mutually positive regard. However, in this case, Helge stresses that he would rather fill his function of activating the attendees, which is to play music, than feed Tonni manually. Helge is thus limited positive towards Bestic.

Space and task appear to be important with regard to successful implementation of Bestic. The day care center is an activity offer and values playing music together. As long as Bestic frees up time it is welcome. Yet, at the home institutions the CPs express doubt as to the value of FAR. They constitute 'homes', the CPs' say, and thus articulate certain and interesting imaginaries in relation to robotics. Helle, a CP in Tonni's home-institution explains, '*Here it is important that we do the things that you do at home… When we eat, we sit down and therefore we are together. We are a home. There are some specific values that apply*'. As such, Helle emphasizes the particular context and style that applies to 'home' and as such, she questions whether Bestic has a role to play. In a home, you eat cozily together and not alone with a robot in your room, we learn. However, this is exactly what Tonni wants to achieve.

While the CPs at the day care center are fond of Bestic and see it as a tool for their use, the CPs at home stress that Tonni invariably ought to decide when to use Bestic. Helle worries that Bestic may be 'too convenient' and due to potential coming budget cuts, soon Bestic needs to function without the assistance of a human. As another CP puts it, '*It should not be so that Tonni uses Bestic because he has to*' (due to savings of personnel). Tonni agrees; '*I am the one to decide. Sometimes, if I don't want to use Bestic, I let it stay at home*'. In other words, he insists that Bestic is his tools. It is not the CPs' tool.

An important fact necessary to understand this is that Tonni loves technology. Technology enables him to have agency. His primary interface with his surroundings is a control box and a joystick mounted on his wheelchair. By way of this, he opens and closes the bedroom door. He controls the curtains and even the ventilator in the kitchen. He uses the joystick and control box to navigate his phone, put on music (also in the bathroom), and start movies. During evenings, Tonni prefers to eat alone with Bestic in his room while watching a movie. Unfortunately, there are important constraints. The CP needs to remove the control box to attach the eating table on the wheelchair, and thus Tonni is cut-off from interacting. The CP places Bestic with a Velcro strap so it does not fall or move; serves the food, starts a movie, and leaves the room. Tonni now eats alone, and that is an achievement, but he has no control besides simple activation of Bestic. He explains he is afraid of choking on the food and suffocating. If that happens, he cannot contact the CPs. He may shout, but no one will hear him, as during mealtime the CPs are busy in the dining room. If he wants to change the movie, he cannot. He can only wait. Because of this, the CPs have recently decided that Tonni can only eat alone in his room (with Bestic) when three CPs are at work. In the future, exactly due to Bestic, the CPs' fear they are scheduled to be only two at work at dinnertime. This tells of controversy in regards to the Bestic-implementation. A number of dilemmas in relation to savings, ambitions to take control of one's own life and flexibility of the working environment appear. In this case, those aims work simultaneously and collide.

This point relates interestingly to the notion of robot envelopment. In the literature, robot envelopment is a matter of organizing the environment so that it meets the needs of the robotics [34]. Tonni is actually able to eat alone in his room with Bestic, but, because the CPs need to dismantle the joystick to mount Bestic, he is cut-off from all other technologies. FAR surely is not properly enveloped. Thus, Tonni can eat alone, but he is left incompetent due to lack of integration among technologies. Because of incidences like this, the CPs see Bestic as impairing care.

3.2 The care providers – the sociotechnical imaginary of impaired care

Tanja also had trouble in using Bestic and stopped after five months. It was difficult for the CPs to make Tanja sit right at the table. For instance, she has a flex arm and a cloth attached to the wheelchair. Therefore, because she could not get close to the table, Bestic did not

work properly. After some time they got another table, but then there was no space for the footrests mounted on her wheelchair. The CPs had to unmount the footrests at the beginning of every meal and reinstall them afterwards. Consequently, Tanja had trouble keeping her balance during meals, which is essential when using Bestic. The CPs tried to support her feet in various ways with a stool and pillows. The occupational therapist was involved and tried a number of options. She made drawings and templates to show exactly where Tanja ought to sit in relation to the table and Bestic. However, in order to eat comfortably Tanja had to place herself so close to the table that she could neither grab the cloth, nor press the blue panel to activate Bestic. After some time, she began to have neck-pain, likely due to a strained eating position. Furthermore, the spoon broke twice, the first time because Tanja had been stuck. Thus, there were continuous material and emotional arrangements, rearrangements and resistances. One day, Bestic fell on the floor, broke down and was sent to Sweden for repair. In fact, it never came back. In the meantime, Tanja ate with the CPs. The CPs then decided to abandon FAR. The contact person says, '*When Bestic broke down Tanja came back to the table and had social contact with the group again. It was as if Tanja, due to the [Bestic] table arrangement, was at a distance from the group. She was in a way sitting at the end of the table all by herself. She had come too far away and this made the contact difficult. I think she missed contact*'.

I suspect Tanja still wants to eat with the robot. Unfortunately, Tanja is a vulnerable person and does not articulate that wish well. Mostly, she communicates through sounds not easily understood. However, during the interview, Tanja continuously stresses that it makes a difference who helps her, and that the CPs do not have equally positive opinions towards robotics. Nevertheless, the contact person believes that Tanja prefers to sit together with other residents while eating, to have contact and enjoy empathy. Like Tonni, Tanja ate well with Bestic at the day care center. At the two home institutions though, intricacy and comprehensive tinkering emerged. Again, imaginaries of 'good' care differ. While, Bestic helps the day care center to focus on their primary activity, music, the home institution doubts whether Bestic is appropriate in a home.

Thus, Tanja's use of Bestic entangles in different sociotechnical imaginaries. It begs ethical questions of what is the most worthy; to eat self-reliantly with Bestic or to experience contact during the meal with fellow residents. While there are hardly any answers to that question outside the specificities of situations, the CPs blame themselves when the body-robot arrangements do not function. '*It could have been otherwise if we had done more*', a CP said as a response to why Tanja stopped. This points, on one side, to insurmountable tinkering to match bodies and aids that comes with Bestic. On the other side, the Tanja case points to a situation where CPs face a technology they believe impairs caring and which, at the end of the day, might take their own job. I can sum up this section by stating there are various perspectives among CPs in relation to the usefulness of Bestic, tinkering is necessary to make it work as is buying in to the imaginary of robotics being enabling of a more agential life. In the next section, I explore the imaginary that good care with assistive robotics assumes empowerment, education and training.

3.3 The technology developers – empowering the user as a sociotechnical imaginary

Camanio Care in Stockholm designs and sells Bestic. A factory in Eskilstuna, Sweden assembles it. Just like the usage stories, the Bestic design story includes interwoven technology and people. An engineer in automation and mechatronics, who had recently graduated university, met an affluent economist suffering from post-polio. He had a dream of producing an eating aid for himself. She was looking for a job, and eventually they started designing the first version of Bestic in 2004. Patients at hospitals with amputated arms acted as informants throughout the early design process. At a later stage, the design process took place in close collaboration with a group of three design students from the university doing voluntary work. They worked on the Bestic design case as part of their Masters project. For half a year, the development engineer even had an office at the university. Thus, in close collaboration, they designed Bestic. The first versions of Bestic came with a five-button control panel. It had arrows and colored buttons indicating arm-directions and speed. It appeared too complicated for many users. To compensate, they developed the simple blue one-button panel to activate the arm and spoon. Consequently, the robot can be set to different programs depending on rhythm of the meal, and the users' physical and cognitive ability. Furthermore, in relation to start-up, Bestic is individually set in terms of exact position, how far the arm swings out, and how high and deep it goes. As soon as it is individually set for a certain user, it does not need adjustment.

The CEO and the developing engineer at Camanio Care expound four ethical claims in connection with practical use of Bestic: 1. Empowerment, 2. Usability, 3. Changes in meal-routines, and 4. Education. The first and most important claim is the question of empowerment. Empower-

ment is, according to the technology developers, an issue of really wanting to support and help the user. The FAR user ought to control decisions. Therefore, empowerment is about respect, caution and security. The CEO says,

Being fed by a person may very well feel more unethical than eating by yourself with an aid. Those coming to help me can be anyone who I do not know and who do things more or less the way I prefer. To say that humans are always ethical and machines are always unethical is too black and white. Humans do not necessarily represent the ethical dream. One can seriously problematize the extent of human empathy.

Secondly, according to the developing engineer the questions of usability and aesthetics are crucial. Usability was a guiding principle throughout the design process. A meal is not simply about eating, nor is it only a matter of moving food from the plate to the mouth, rather the meal is a cultural setting to which we have all kinds of expectations. Among other things, it relates to community, gathering and conversation. The development engineer says, '*at almost every celebration we have a meal. That is what we want the users to be part of. So, Bestic shouldn't stick out too much*'. In order to be used Bestic must fit on a table, be neat and blend into the environment. It should not look too much like a robot. The technology developers agree that the earlier models, such as the Neater-Eater robotics, are too prominent and noisy. Consequently, the developing engineer listened to a number of motors, and in order to make Bestic as silent as possible, it ended up having two small motors. The design group wanted Bestic to be white and shiny. Although it is made of plastic, it intends to look like porcelain to fit on a table. Throughout the design process, it was valued that Bestic was easy to clean and wipe off.

Thirdly, roboticists find CPs ought to be prepared to change work routines in relation to the meal. Bestic shifts the meal in relation to what it was before. The financing as well as the development of assistive robotics, is challenging and long term. It takes time and effort to enter the market. Thus, the technology developers explain, it is not fair to see Bestic simply as a commercial product. Rather, it constitutes a new philosophy of the meal. The CPs, for instance, have to charge Bestic in advance, to make sure all the needed elements are in place and they need to serve the right food. Not least, they need to relate differently to the user during the meal. According to the technology developers, the use often stops, because the CPs are not willing to make these changes. It is a key value for the technology developers that the user and not the CPs are in control. If the user controls Bestic, it is ethical, they say. Perhaps, sometimes the users ought to be more assertive and say, '*I really want to use this robotics, could you please help me?*' The point is that assistive robotics is not something you try for a period due to it being funny or interesting. It is a new way to eat, think, care and work. In relation to the fourth point, the technology developers propose there is lack of knowledge. Training is lacking with regard to assistive robotics in formal basic education, as well as in continuing education. The technology developers particularly point at a need for training in understanding the problems arising during a meal. Due to this lacking, there are destructive myths in institutions about savings instead of quality, instrumentality instead of empathy, etc. The CEO says,

The use of feeding assistive robotics does not lead to more quality or less quality in itself; neither does it lead to more or reduced staff in itself. This is a question of what you do with it, but there are often not sufficient staff at breakfast, lunch and dinner. This is where Bestic may or may not lead to improved quality.

Consequently, Camanio Care developed 'Mealtime Puzzle', a course they teach at Karolinska University Hospital in Stockholm. They have also developed an app called 'Mealtime quality index' consisting of a number of questions posed to both CPs and users to consider what a good meal is. The course treats a number of issues during a meal that you have to be aware of - nutrition, speed, senses, physical arrangement, organization, etc.

3.4 The government – the sociotechnical imaginary of digitized care

After a 2011 election in Denmark, in their coalition agreement 'A united Denmark' [35, p. 44], the new government wrote, '*We will work for a more cohesive focus on telemedicine and will promote ambitious and binding goals, which commit regions and hospitals to welfare technological services on a large scale*'. The government coalition agreement mentions welfare technology five times - even as a prominent Danish export article. According to an agreement among the government, the regions and the municipalities [31] there are three goals that need to be justified in order to obtain funding for welfare technology from the Welfare Fund: 1. Labor savings, 2. Quality experienced by the citizen, and 3. Work environment flexibility. The municipalities' financial agreement for 2014 launched a joint municipal effort for national dissemination of mature welfare technology solutions. They promoted this in relation to a plan of a profit realization of 70 million euros. LGDK's social policy proposal titled 'Invest before it happens' states that municipal efforts must be based on the citizens own resources, their active participation and be able to support people's self-determination and independence. Increased use of assistive robotics, they claim,

is one means to realize the visions. In the years 2014-2017 The Center for Welfare Technology produces yearly status measurements for the implementation of the four prioritized welfare technologies. The latest report states that the municipalities have purchased 180 FARs and that 100 of those are in use. At the same time it is stated by LGDK that the municipalities have already realized the projected for profit of the investment.

4 Discussion

The combination of the notions of sociotechnical imaginaries and tinkering is useful in analyzing how different agents organize their worlds of action as a response to a new advanced technology, what their goals are and how they realize these goals. Inspired by material semiotics [9, 11–14], I have presented some crucial sequences of events in relation to implementation of FAR in Denmark that adds complexity to the existing literature on implementing care robotics. Although there have been critical voices [8, 9]. There have mostly been promises regarding the potentials of assistive robotics [2], including better and more cost-efficient healthcare delivery [6], engaged patients and connected health care professionals [32], and engagement of professionals in more patients and users [7]. However, as I have argued and demonstrated enacting these visions is messy, uncertain and complicated, in ways often unanticipated by government agencies and technology developers. The point I am making is that assistive robotics constitute a strong, but controversial sociotechnical re-imagination of care for the chronically ill, the elderly and the disabled as well as the welfare state. This relates to both imaginaries of *savings*, *quality* and *flexibility* in care work. Although, Bestic is indeed such a technology, this study contributes to the existing literature by emphasizing that there are noteworthy discrepancies between the visions of government agencies, technology developers and practical implementation of robotics in care work. These discrepancies interweave and complicate the implementation. In Table 1. I sum up the article's argument/results by displaying four different sociotechnical imaginaries, goals and forms of tinkering in relation to the studied implementation of FAR. See Table 1.

The table illustrates that implementation of FAR comes with a number of differences that have practical effects during the implementation. The point is that sociotechnical imaginaries, goals and tinkering in relation to the four mentioned agents come with tension and embrace controversies.

Table 1. Implementation of FAR - agents, sociotechnical imaginaries, goals and tinkering.

Agent	Socio-technical imaginary	Goal	Tinkering
Government agencies	Digitized welfare/Digitized state	Savings, self-reliant users, flexibility for care providers	Promoting, monitoring
Technology developers	Empowerment of the user	Usability	Educating shifted meal routines
Users	Love of technology	Self-reliance, control, agency	Experimenting
Care providers	Impaired care, An aid improving flexibility	Gathering, community, empathy	Arranging people and technical aids, change tiny details to see if it works

4.1 Implication in practice

What are the consequences of this article's argument for the practitioners involved in policymaking (government agencies), design (technology developers) and implementation (CPs)? This study points to the fact that policy makers need to rethink whether FAR is mature enough and earn mandatory dissemination in all municipalities. Moreover, the study demonstrates that learning needs to be done. Technology developers are, for instance, not involved in implementation, and the CPs at different sites do not communicate. CPs claim at a certain moment that Bestic would be more usable if it was equipped with voice recognition. Technology developers ought to learn from this by attending. In terms of CPs, many point to the possibility that they stop implementation too early due to dichotomization between values of empathy and coldness/instrumentality.

5 Conclusion

This article discusses the complexities that come with technologically driven innovation of care work. I have exemplified from a mandatory national implementation strategy concerning FAR in care for the disabled in Denmark. Analytically and methodologically, I have used inspiration from material semiotics, desk research, observation and stories told by a number of affected stakeholders. The Bestic case elucidates both users' strivings for self-reliance, CPs hassle and tinkering implying threats that the entire health political vision crumbles due to difficulties to make persistent and convincing connections between bodies and robotics. The imaginaries and expectations in relation to assistive robotics are considerably different as the involved agents perform them. As part of this

divide, I argue that imaginaries in relation to the FAR of government agencies, technology developers, users' and CPs' weave into the daily practice and shape present-day practice of care work. As an extension of Mol, Moser and Pols, I propose that much is at stake and that body-robot interaction demands thorough engagement, continual tinkering as well as deep understanding of the particular situation, identity and bodily condition of the user. This study contributes both to the literature on HRI and STS by providing an empirical example based on detailed ethnography done from the middle of things, and in a manner where both political visions, technology developers' assumptions concerning usability, users strive for independence and CPs tinkering, are in focus at the same time. Thus, the analysis invites readers to embrace the scope and potentials of ethnographic methods in the HRI field.

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