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Interfacing RobotCare

On the Techno-Politics of Innovation

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Abstract

The objective of this book is to investigate the emergence of RobotCare within the context of European innovation politics. Here, the vision and project of social robots caring for the elderly is positioned as a necessary and desirable solution to impending demographic change. The following study will not take this interconnection between robotics and care as a given but rather as the product of a wide range of political, technological, and social processes, which have made this project possible in the first place. This presents empirical and analytical challenges, which this book proposes to tackle by way of an *analytics of interfacing*. Such an analytics investigates the practices and milieus of interfacing, which have gradually rendered robotics and care interconnectable. It builds on and seeks to extend existing scholarship in (feminist) science and technology studies, media studies and the philosophy of technology.

At its heart, the present book contains three connected case studies, which focus on different modes of interfacing RobotCare: *infrastructuring, prototyping, and translating*. The first case study focuses on how RobotCare has emerged within European innovation policy discourse through particular rationalities of interconnection. The plausibility and desirability of RobotCare is the product of a number of *infrastructural* reconfigurations of European policy in the past two decades. The second case study investigates a robotics R&D project, which aims to realise *prototypical* interconnections between robots, elderly people and care-like environments. Roboticists must continuously tinker with and stage those interconnections in order to stabilise them temporarily. Finally, the third case study enquires into an EU-funded project of public procurement, where public end-users are included in the task of rendering robotics a valid solution and marketable product for geriatric care. In order to do so, the involved actors, e.g. roboticists, users, and robots themselves, need to be continuously interested in this endeavour and, consequently, *translated* in different ways.

This extensive analysis shows that both robotics and care had and still have to be profoundly reconfigured and rendered available for one another in order to become fitting components of the vision and project of RobotCare. Furthermore, these efforts to interface RobotCare betoken a more general regime of contemporary politics. They manifest a *techno-politics of innovation*, which presumes an almost universal interconnectability of technology and society. As a consequence of this diagnosis, the present book proposes to decipher and question the conditions and modes, by which this rationality of interconnectability operates, as the main vehicle for critique.

List of abbreviations

AAL	Ambient Assisted Living / Active Assisted Living
AHA	Active and Healthy Ageing
CGA	Comprehensive Geriatric Assessment
CSA	Coordination and Support Action
CORDIS	Community Research and Development Information Service
EC	European Commission
ECHORD	European Clearing House for Open Robotics Development
ECHORD++	European Coordination Hub for Open Robotics Development
EIP on AHA	European Innovation Partnership on Active and Healthy Ageing
EU	European Union
euRobotics AISBL	euRobotics Association Internationale Sans But Lucratif
EURON	European Robotics Research Network
EUROP	European Robotics Technology Platform
FP	Framework Programme for Research and Technological Development
HRI	Human-Robot Interaction
ICT	Information and Communication Technologies
MAR	Multi-Annual Roadmap
PDTI	Public end-user Driven Technological Innovation
R&D	Research and Development
SPARC	Partnership for Robotics in Europe
SRA	Strategic Research Agenda
WHO	World Health Organisation

1. RobotCare – a (not so) stable interconnection

> Scene 1: On 17 December 2013 the European Commission's Vice-President at the time Neelie Kroes and Bernd Liepert, President of euRobotics, the European association of robotics, sign the contract for SPARC, a public-private partnership of unprecedented proportions in the history of robotics. €700M in public and triple that in expected industrial funding make it the world's biggest civilian innovation programme in robotics. In the eyes of its protagonists, Europe urgently needs robots. The partnership's research agenda prospects that elderly people will make over 30% of Europe's population by 2050. That means more people to care for and less people to do the job. Interactive robots able to care for an ageing society, seem to be an inevitable solution to this problem.

> Scene 2: On a sunny June morning in 2015, Francis, a computer science professor, and his team are busy working on their robot prototype in a Scandinavian care facility. They conduct a series of pre-tests with middle-aged users in an assisted living apartment. Nobody lives there. The researchers are members of the local innovation network and use the apartment to demonstrate their prototypes with users. On that particular day, the robot is supposed to fetch a bottle of water from a table in the living room. When the robot tries to slowly grab the bottle, it misses by a little bit and knocks the bottle over. Just in that moment, Francis is lunging out, putting the bottle up again and into the robot's grappler[1]. As the robot is attempting to grasp the bottle, it is missing again but pulling back its arm anyway as if it had successfully caught the bottle. "Oh come on, stupid robot", Francis is calling out. He is approaching the robot again and now finally managing to hand over the bottle into the robot's retrieving grappler.

> Scene 3: It is a cloudy October day in 2018. In the hospital of a coastal town close to Barcelona, a geriatric physician oversees two different teams of roboticists whose robots should perform a series of standardised assessments with elderly people. It is important for the teams to impress the doctor, since his judgement is decisive for whether the hospital will invest in one of the devices or not. After all, it was his idea to use a robot for the so-called Comprehensive Geriatric Assessment. It could save him and his colleagues valuable time, he hopes. One of the proposed designs simply consists of a box with a camera in it and a tablet. The doctor likes that idea. It is much simpler and cheaper than the other team's design, a big, mobile robot with a 'head' and 'eyes'. During the tests, I am asking participants whether they think the box is a robot. I get very conflictive answers. Nobody seems to know for sure what a robot in geriatric care should be like or whether it should be a robot after all.

At first glance, one could conclude that these three scenes tell three different, even contradictory stories about the relationship between robotics and elderly care. In the first scene, one can witness European innovation policy in operation, where robots are heralded as the saviours of an ageing society. This political discourse is embedded in a society, where economists,

[1] 'Grappler' is the technical term for an actuator fastened to an extendable 'arm', with which the robot can grasp objects in its physical environment. In the above example, the grappler resembles a claw with two movable joints.

engineers, and journalists almost daily announce the advent of a "second machine age" (Brynjolfsson and McAfee 2014), the oncoming "next wave of computing" (Breazeal 2014b) and the "robot revolution" (Westlake 2014, p. 9). In this overarching narrative, robots are expected to become more intelligent, interactive and even social by the day. In the near future, they are believed to confront humans not simply as dull machines but as social counterparts able to care for people (Breazeal 2002). The backdrop for this is a society in crisis or, what critical gerontologist Stephen Katz has described, an "alarmist demography" (Katz 1992). If we do not do something (i.e. invest in the development of robots), the "aging tsunami" of elderly people will overwhelm 'us' (Barusch 2013), that is, a (post-)industrial society in desperate need of ever increasing levels of productivity and growth.

The second scene seems to suggest an entirely different story. When following roboticists into their labs demonstrating even the easiest of tasks (e.g. fetching a bottle of water) they often fail. Even more so, they are in constant need of support in order to more or less muddle through the kinds of assistive services an ageing society expects from them. The professor's courtesies described above are no exception here. During the tests, the team is removing carpets, tidying up the surroundings, and putting blue plastic bags around their feet so no dirt from outside can jam the wheels of the robot. Additionally, the above described 'pre-tests' feature middle-aged not elderly people. Users need to be fit enough in order to be assisted by a machine. So, robots play a very different role here than in the first scene. They are not omnipotent saviours of an ageing society but rather fragile beings. It seems like these 'stupid' robots do not care for people but, rather, people need to care for them. Compared to the flamboyant promises made above, the story of care robotics is one of constant tinkering and repair. The little courtesies by Francis seem to unmask robotics as more an awry exercise in Science Fiction than a real prospect in the near future.

Finally, the third scene seems to unveil another story all together, namely, that robots might be closer to care already than many dare to think. Next to the discourse staged in scene 1, there is a broad discussion about the potential negative effects of robots in elderly care. Especially in Western societies, the prospects of robots roaming the corridors of care homes provokes uncanny images of elderly people spending their twilight years devoid of any human contact (Pols and Moser 2009). Underlying this line of argument is the assumption that robots simply cannot do what humans do, especially, when it comes to 'essentially' human qualities such as empathy or love (Sparrow and Sparrow 2006). Despite these reservations, the protagonist of the third scene, a geriatric physician, is eager to let robots finally take over, i.e. perform regular assessments in his ward. However, his favourite design does not at all resemble the human-like machines featuring in critics' nightmares or in SPARC's glossy brochures. In the end, the 'robot revolution' might be spearheaded by nothing more than a camera in a box.

While these scenes seem to tell different stories about robotics and elderly care, partly even contradicting each other, they converge in an important aspect. In all three stories, robotics and elderly care are taken as interconnectable, even as compatible. While the above described attempts to connect robots and people are more or less successful, the protagonists never put into question, whether robotics and care actually fit together. This is precisely where the following research intervenes not by simply negating that assumption but rather by taking a step back and asking: Why do so many actors, policy makers, newspapers, engineers, doctors, ethicists, and many others, discuss this topic at all? Put differently: How has it become so plausible to talk about and work on (or against) bringing together robotics and elderly care in such different places as a European-wide partnership, in a care facility somewhere in Scandinavia and in a Catalonian hospital?

When asking this question seriously it is indeed astonishing what both of these domains have to do with each other at all. Where is the link between, on one hand, a bunch of roboticists programming, assembling and testing robots and, on other hand, caregivers, nurses and doctors caring for elderly people? At first glance, not much. In fact, when looking at funding programmes of the European Commission at the turn of the millennium, neither of the two topics feature at all. However, about fifteen years later robotics has become one of the most funded areas of ICT research in Europe (European Commission 2017, p. 3, 2016c, p. 3) and an ageing society is prominently discussed in terms of the commercial opportunities promised by a "silver economy" (European Commission 2015b). On top of that, both topics have become inseparably connected to one another. Almost no media article, policy paper or scientific publication about either humanoid robots or demographic change can avoid the reference to the other in one way or another. Discursively, these two elements seem to have consolidated within a more or less stable interconnection: *RobotCare*.

The starting point of this book is to not take this link as a given. Robotics and elderly care did not 'find' each other out of some 'historical necessity'. They also did not emerge by themselves randomly. Rather, they are the *product of a wide range of political, technological, and social processes that have gradually interconnected robotics and elderly care*. The basic question here being: *How, through what kind of practices and under what kind of conditions, have robotics and care been interconnected?* Such practices and conditions are necessarily distributed across different contexts as exemplified by the three scenes at the beginning of this chapter. For the analysist, this presents the challenge to draw these albeit different contexts together under one conceptual roof. To speak with Foucault,

> "[t]he problem now is to constitute series: to define the elements proper to each series, to fix its boundaries, to reveal its own specific type of relations, to formulate its laws …" (Foucault 2013[1982], p. 8)

For Foucault coming from his book on 'The Order of Things' (Foucault 1970), the notion of the series was a tool to open up his own method of reconstructing history in terms of grand epochal breaks. Instead, constituting series means to attend to the more fine grained "ever-increasing number of strata" (Foucault 2013[1982], p. 8) that make the phenomena of his archaeology of knowledge. The challenge is thus to not tell these different strata apart while at the same time still being able to analytically distinguish them. In the case of this book, each of those three scenes makes such a stratum of RobotCare, which tells the analyst something about how robotics and elderly care could become interconnectable and still are becoming interconnected. For example, in the first scene, RobotCare has been established as part and parcel of a particular regime of innovation policy. Here, one condition of this interconnection rests on the displacement of funding priorities within the European Commission from scientific ones to ones concerned with technological innovation and solving societal challenges (Kaldewey 2013). This also reflects in the second scene, where roboticists are not only expected to tinker and run a piece of technology but also, by doing so, should demonstrate robots' viability and acceptability in care environments. Robots are charged here with the political imperative to solve the looming perils of demographic change. Finally, in the third scene this translates into the mission to bring robot prototypes into actual care practice by teaming up robotics and health professionals.

This shows that the scenes are in fact connected to one another within a series that we might call *European innovation politics*. Employing the notion of the series, makes the conducted research both specific and generalisable: On one hand, it focuses the attention on a particular context, in which RobotCare articulates itself. This excludes other possible research focuses, like for example media discourse (Meinecke and Voss 2018), epistemic culture (Bischof 2017), or care practice (Pols 2012). On other hand, it allows for taking the specific phenomenon of RobotCare as a proxy for analysing the *modus operandi* of politics, a techno-politics of innovation. So, instead of studying those three scenes as separate cases (for policy, technology development, and technology transfer) the following book will take them as particular manifestations of the kinds of practices and conditions, under which RobotCare could come into being. The central hypothesis being that this could only happen within the context of European innovation politics due to the emergence of a techno-politics of innovation therein.

1.1. Analytics of interfacing

How to respond analytically to this research interest? How to grasp the accomplishment, that is, the interconnection of RobotCare but at the same time attend to it as an ongoing open-ended process that is constantly on the verge of breaking down, coming to a halt? In this book, I propose a particular analytical trope through which to tackle that problem: an *analytics of interfacing*. Interfacings describe the manifold processes, by which elements in various forms are rendered available for one another. It thus captures the ways in which robotics and elderly care are (re)appropriated, (co)adapted, and (re)configured in order to become interconnectable. Again, the criteria, which determine this 'interconnectability' are taken as situated within particular contexts (e.g. in a robotics R&D project or European innovation policy discourse) and rendered explicit in such an analysis, not delegated to essentialist assumptions about what care and robotics 'really' are. This perspective is based on two theoretical tenets derived from existing conceptual discussions in Science and Technology Studies (STS), feminist STS, media studies, and philosophy of technology: analyses of interfacing are essentially based on the assumption of (1) *procedurality* and (2) *radical relationality*. This understanding of interfacing is most importantly inspired by and developed through Gilbert Simondon's concern of an operational philosophy of technology (Simondon 2009, 2017) and Karen Barad's agential realism (Barad 2003, 2007).

The first tenet holds that interfacing essentially denotes a process not a fixed entity. With this, I both build on but also divert from accounts of the interface in media studies. There, digital interfaces denote paramount objects for investigation. For example, Branden Hookway has offered a genealogy of the concept of interface, which has originated in thermodynamics and has come to play a decisive role in cybernetics as well as contemporary technologies. He then uses his own concept of the interface as "relation with technology" (Hookway 2014, ix) to analyse configuring processes of users in technical apparatus like the pilot cockpit. Elsewhere, another media theorist, Alexander Galloway, has centred his attention on interfaces and how they materialise digital culture claiming that "[i]nterfaces are not things but rather processes that effect a result of whatever kind" (Galloway 2012, vii). Still, both scholars focus largely on (digital) user interfaces as particular entities, either in the shape of pilot cockpits (Hookway) or as products of contemporary digital culture (Galloway). And yes, user interfaces will play a role in this study, too, when for example roboticists try to calibrate users' voices to a robot's speech interface. However, I am not primarily interested in the speech interface itself, e.g. the voice recognition software, the microphone, or the language database. Rather, the analysis is about how roboticists attempt to interface, what I call, ‘corridors of interaction’ (see chapter 5.2.4.), i.e. particular avenues of persistent co-adaptation between the robot’s speech interface and the user’s body. Hence, I think about the interface in terms of a set of practices, which are set out to install the conditions to make interaction work in the first place. This means that the speech interface is itself only one of the elements interfaced in this process. Hence, my interest in the trope of the interface pertains to interfac*ing* as a set of practices, which work on rendering different entities available for one another. This perspective owes itself to the philosophy of open objects proposed by Gilbert Simondon. He views the problem of constructing objects as an ongoing process: “to construct a technical object is to prepare an availability” (Simondon 2017, p. 251). Things do not fit as they are but they need to be worked on within a “regime of operation” (Simondon 2009, p. 17), for example, the human-robot interaction experiments in the test apartment mentioned above. Hence, we should not be talking about interfaces anymore but about *interfacings*, that is, processes by which heterogeneous elements are rendered available for one another.

The second tenet holds that interfacings entail radical relationality in the sense that the elements to be interconnected are not relevant with regard to their ontic ‘essence’ but rather with regard to their ‘superficial’ interconnectability. Thus, all elements involved in processes of interfacing are constituted in their superficiality *vis-à-vis* each other (albeit in different ways). For example, in order to pilot robots in a test apartment, such as the one described above in scene two, it is not only the surroundings that are adapted to the robotic system but rather roboticists are constantly working on adjusting the robot’s parameters and configurations as well. This might be due to a change in lighting in the flat or an unexpected error somewhere in the system. Roboticists are themselves involved, bodily and mentally, as they constantly need to find new ways to fix mishaps between the many elements present during the tests: a particular piece of software or hardware ‘in’ the robot, something the user says or does (or fails to say or do), mundane objects that unexpectedly interfere with the tests and so on. Here, Karen Barad’s agential realism and her concept of ‘intra-action’ radicalise accounts of interactive relationality (Barad 2003). She posits that instead of simply interacting with one another as pre-existing sources of agency, such elements are mutually *constituted* and reconfigured by entering into a relation. This has two important consequences: On one hand, it even further displaces the analysis from questions of ontology (e.g. can robots ‘really’ care as humans can?), because the primary interest now lies on the conditions under and the modes through which elements constitute one another in a given situation. On the other hand, it elevates the analysis' focus on the relations respectively interconnections instead of single elements (Barad 2003, p. 821).

To conclude, interfacing signifies a process, which does not only render elements available for one another but also *constitutes* and *reconfigures* them.

1.2. Robotics and care

Within European innovation policy discourse robotics has largely been viewed as supplier of industrial machines. This has changed in the course of the past two decades, where service and social robots become an important topic for research and development (European Commission 2011). Such systems should operate in close proximity to humans by way of physical and social interaction (Breazeal et al. 2008). Their technological base differs from the one of industrial robots, in that, the latter are embedded into controlled environments, such as, a factory cage. In it, they are supposed to act in a repetitive and highly precise matter. By contrast, service and social robots are expected to deal with uncontrolled, highly unpredictable environments, for example, at home (Robinson et al. 2014) or in care facilities (Abdi et al. 2018). In such environments, robots should perform services *vis-à-vis* human counterparts, for example, handover a bottle or guide an elderly person through a geriatric assessment. Such systems often but not always have human-like features, either as a functionality (e.g. speech-based interaction) or as part of the outward design (e.g. camera sensors concealed as 'eyes'). Hence, the kinds of robots and the configuration of robotics dealt with in this book ranges within the above described corridor. Robots are not taken primarily as industrial machinery[2] but as interactive machines, which are more or less able to operate in close proximity of (elderly) people. This does not mean that this study will only talk about 'social' robots in a strict sense. Rather, the supposedly 'social' aspects of robots are more or less configured depending on the respective context and can, at times, even be the object of controversy.

Also, the notion of care is not one that is easily defined. For example, European innovation policy discourse has largely configured care as 'healthcare' up until a certain point (see chapter 4.2.2.). This meant that the groups appearing within that discourse in relation to new information and communication technologies, were framed as patients, which also but not only included elderly people. This focus gradually shifted towards the *social* care of elderly people.

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[2] Although, it has to be noted that there are industrial applications for interactive robots, which operate as 'co-workers' in immediate interaction with workers at the assembly line. Hence, one could argue that the very notion of the industrial robot is changing under this new paradigm.

Here, it is important to understand that the distinction between social and health care is not defined in this discourse but rather implicitly draws on (national) legal frameworks, such as, the British National Health Care Service. Here, both forms of care are defined according to the specific needs (health vs. social inclusion) and the kind of techniques applied to these needs (medical treatment vs. daily assistance) (British Department of Health 2012, p. 50). For the understanding of care in the context of this study it is important that this only matters with regard to what difference it makes with regard to the interconnection of robotics and *elderly* care, in each specific context. Elderly care can be about health (e.g. the geriatric assessment) or about everyday assistance (e.g. in the test apartment). However, this distinction matters only insofar as the switch in emphasis from the former to the latter has resulted in a shift of the kinds of disciplines that have become related to the topic of ageing within the context of European R&D funding (biomedical disciplines vs. engineering, see section 4.2.). In other words, it is significant with regard to the question of whether and under what circumstances care becomes component of RobotCare.

Hence, making the interconnection of robotics and elderly care the central object of research prevents this study from strictly defining what kind(s) of robotics and what kind(s) of care feature as relevant. The ways, through which both have become interconnected vary largely according to context. Hence, the purpose for studying this phenomenon lies, on one hand, in teasing out the specific (re)configuration of both elements *vis-à-vis* each other and, on the other, in gaining an understanding of the *overarching* modes and conditions, under which this happens.

1.3. European innovation politics

The three scenes introduced at the outset of this chapter are empirically linked. Even more so, they are, in one way or another, embedded within a single context, European innovation policy. As alluded to above, SPARC is the product of a long coordinative process between the European Commission and euRobotics. It is funded by the EU, which also applies to the robotics R&D and public procurement project described in scene 2 and 3. Hence, the funding EU programmes, infrastructures and project funds that underlie all three cases certainly justify analysing them together in terms of a series (for the analysis of the particular policy context, see chapter 4). However, the notion of 'policy' falls short of the many strata that are comprised in the phenomenon of RobotCare. As argued before, the R&D project of scene 2 is confronted with a different kind of empirical reality of RobotCare, namely, to make robots work in care-like environments. This is why the overarching series that this study endeavours to string together and investigate is called European innovation *politics* and not simply policy. I consciously use the former term over the latter, because this book is not only about what the European Commission writes in its policies, e.g. their funding programmes, but rather about how, through what kind of political rationalities, these policies are enabled and organised. Here, the series of European innovation *politics* introduced earlier does not simply represent, in Foucault's words, a particular form of *problematisation*. With this term, Foucault analyses how a particular kind of social, political, epistemic order "defines objects, rules of action, modes of relation to oneself" (Foucault 1984, p. 49). Such an order is neither a rational necessity nor merely a historic variation but rather it denotes that, which structures what kind of knowledge, power, and experience participants in a particular historical moment can have of or in it.

Analysing RobotCare in terms of a particular problematisation means to attend to the ways, in which such knowledge, power, and experiences are organised. To repeat the puzzle from the beginning of this chapter: Why, one might ask, is the interconnection of robotics and elderly care so conceivable after all? Why is it plausible to take (robot) technology as the primary source for solutions to political problems? Why is demographic change in particular problematised in this way? One could think of so many alternatives, such as, find ways to recruit more care personnel, use other more reliable types of technology for care or come up with new models of collective (instead of 'independent') ageing. Yet, it is this *particular* interconnection of problem (elderly care) and solution (robots), which seems to be especially influential. Speaking with Foucault, this is not the case because of some 'natural' compatibility between robots and care nor is it simply random. Rather, this interconnection relies on a particular (and one might add: political) problematisation.

This means that the study of the many ways, through which RobotCare as a phenomenon is interfaced, opens up an additional question: *What does the case of RobotCare stand for? What do the ubiquitous efforts in Europe to interconnect robotics and elderly care tell us about the state and operation of contemporary politics?* As has been adumbrated in the sections before, (robot) technology is integral to this kind of politics and the society, in which this politics is situated. However, this concern is not simply about the fact that contemporary political discourses revolve around material technologies but rather that technology and politics enter into a particular relation with one another. In the words of Andrew Barry,

> "[w]e live in a technological society, I argue, to the extent that specific technologies dominate our sense of the kinds of problems that government and politics must address, and the solutions that we must adopt. A technological society is one which takes technical change to be the model for political invention. The concept of a technological society does not refer to a stage in history,

> but rather to a specific set of attitudes towards the political present which have acquired a particular contemporary intensity, salience and form." (Barry 2001, p. 2)

The first scene described in the prelude exemplifies this "political preoccupation" (Barry 2001, p. 2): In that scene, demographic change is translated into a technological problem, i.e. developing interactive robots for elderly care. In this sense, setting up the SPARC partnership is equipped with unprecedented political urgency. It brings together policy makers and roboticists in a joint public-private partnership in order to tackle, amongst other things, an ageing society. This is part and parcel of a societal attitude towards what constitutes appropriate political action in the present. In viewing RobotCare as a case for the operation of a particular political attitude allows to tell the three stories not only as tightly connected to one another but also within one methodological frame.

As shown in the prelude's examples, RobotCare and the herein comprised political attitude is not restricted to government or politics in the classical sense of state institutions (Foucault 1995, 1998). Yes, the two protagonists in the first scene could be attributed the status of official political actors but one would miss a lot about the phenomenon of RobotCare if one were to view the overall series as simply political institutions exerting power over everyone else, e.g. the roboticists and the geriatric physician, who would then merely execute the formers' agenda. Instead, following again Foucault power relations are not restricted to political institutions but rather are dispersed throughout society:

> "from state to family, from prince to father, from the tribunal to the small change of everyday punishments, from the agencies of social domination to the structures that constitute the subject himself, one finds a general form of power, varying in scale alone." (Foucault 1998, pp. 84–85)

Foucault has analysed power relations in very different sites and discourses, such as, prisons (Foucault 1995), clinics (Foucault 2003b), sexuality (Foucault 1998) and so on. In the case of this book, it is not only euRobotics and the European Commission, who subscribe to the vision and project of RobotCare. Rather, it operates in laboratories, in living labs, hospitals, universities, it operates in the meticulous efforts of roboticists to re-arrange an apartment so that robots can navigate in it, it operates in the creative process of a geriatric doctor, who re-thinks his professional practice in light of potentials for automation, it operates in funding programmes, architectures, and research projects. This renders available an important point: instead of distinguishing politics and engineering, political agendas and material technologies, it rather shows that the technological has entered the space of government – and *vice versa*. Following Barry this means that, for example, the sites, where politics is situated, as well as the logics by which it operates, change (Barry 2001, pp. 201–215). Here, sites of demonstration, such as the test apartment described in the second scene above, are imbued with political properties, since they should not only demonstrate the functionality of a piece of technology but rather the

> "social/legal plausibility and acceptability by end-users of a plurality of complete advanced robotic services … which will … favour independent living, improve the quality of life and the efficiency of care for elderly people" (Project website[3]).

In other words, the grasp of a robot in a Scandinavian care facility is part and parcel of a whole array of political hopes and agendas, which constructs the political realities that we live in.

This is where Foucault's notion of the apparatus[4] comes in. It allows for analysing these heterogeneous phenomena, the robot experiments with users, the SPARC partnership, and the demonstrations in the Catalonian hospital, within one framework. The concept of the apparatus describes the way relations between power and knowledge bring about political realities. In other words, it examines "strategies of relations of forces supporting, and supported by, types of knowledge" (Foucault 1980, p. 196). In the case of RobotCare an 'apparative' analysis enquires into the ways, through which power/knowledge is organised in such a way for RobotCare to become a political reality. Foucault's perspective posits that political problems (and solutions) do not emerge out of a rational necessity. Rather, they depend on processes, which rationalise the world in such a way for them to become plausible to be talked about and acted upon. In other words, the emergence of particular political rationalities

> "structures specific forms of intervention. For a political rationality is not pure, neutral knowledge which simply 're-presents' the governing reality; instead, it itself constitutes this intellectual processing of the reality which political technologies can then tackle." (Lemke 2001b, pp. 190–191)

In this book, I will argue that there is a shift in these kinds of political rationalities applied to problems of population. While Foucault has equated the emergence of biopolitics with the establishment of an apparatus of security, I will argue that power/knowledge in the case of RobotCare in particular and European innovation politics in general acts through an *apparatus of innovation*. In this configuration of politics, the primary problem is not to regulate populations according to the dispersion and prevalence of illnesses within the population body. Rather, demographic change is constructed as an opportunity for re-designing and re-building

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[3] The placeholder 'Robotics R&D project' refers to the project analysed in chapter 5 and introduced in scene 2.

[4] Since the original French term 'dispositif' is almost impossible to adequately translate into English, see Dreyfus and Rabinow 1983, pp. 119–121, I will stick to the term apparatus, which is the most common translation in the Anglophone reception and translation of Foucault's work.

society through and in accordance with technology. As Barry argues, it "takes technical change to be the model for political invention" (Barry 2001, p. 2). We see this, for example, in European policy discourse, where the grand challenge of ageing is seen as an unprecedented opportunity for developing innovative technologies and stimulating economic growth (European Innovation Partnership on Active and Healthy Ageing 2011a). This also manifests on the level of development, when, for example, robot prototypes are confronted with expectations of marketability or acceptability by users. It also shines through when looking at the third of the above scenes, where a geriatric doctor is co-creative part of the innovation process expected to render robot technology more compatible with the 'needs' of geriatric care.

This is where Barry's discussion of technology and politics, Foucault's apparative analysis, and the previously introduced analytics of interfacing come together: In its most audacious form, the argument of this book is that the manifold efforts to interface RobotCare betoken a new rationality of doing politics with and through technology[5]: a *techno-politics of innovation*. In this sense interfacing RobotCare does not simply manifest a particular type of technology (robotics) nor a particular political problem (demographic change) it rather constitutes a resonant call for action of how to establish social and political order within a through and through technologised society. Interfacing in its most general form, denotes the techno-political *modus operandi*, by which politics (and the critique of it) can become possible. It constitutes the condition of possibility for something to become political.

1.4. The argument outlined

Even though robots are almost non-existent in actual care practice, the vision of RobotCare has provoked a lot of controversy in recent decades. Chapter 2 will thus investigate the ostensibly main two positions within this discourse, the *humanist* and the *solutionist* position. The former calls for a timely export of intelligent, assistive, social robots into elderly care as a technological fix to a range of different social, political and economic problems. The latter largely repels this attempt as an act of colonisation. It fears that robots may violate or even substitute the integrity and humanity of care work. Both of these positions are targets of multiple STS critiques, which form an additional position in this discussion: Here, scholars mainly put into question the essentialist assumptions about robotics and care as two distinct spheres, robotics as a purely technical and care as a purely social domain. As its main critical vehicle, STS mobilises the

[5] This does not mean that I argue for an epochal break with bio-politics in general. Rather, this denotes another example for how established Capitalist orders show their ability for restructuration, see Lemke 2001a, p. 26.

assumption that technology and society are intimately interconnected and, thus, cannot be neatly separated. A growing body of scholarship applies concepts and arguments derived from this critical position to understand and investigate the ambivalent role of robots in care as well as care in robotics. This critical, anti-essentialist perspective denotes an important first step to uncover some of the underlying assumptions in public (and scientific) discourse on robotics and care. However, both topics have largely been studied separately in STS. Consequently, research that aims to uncover the particular processes, by which science, politics, media, users and others *interconnect* robotics and elderly care in the first place have remained scarce.

This is why chapter 3 will displace the analysis from simply looking at either care or robotics towards looking at them in the process of being interconnected within European innovation politics. Drawing on Foucault's concept of the apparatus I argue that there has been a shift in the political strategies and tactics deployed to deal with problems of (an ageing) population. These are not organised anymore within an apparatus of security seeking to regulate and manage populations but rather within an *apparatus of innovation* aiming to redesign and transform societies according to imperatives of active ageing and innovation. In this context, elderly people are not primarily viewed as a threat to societal order but as a valuable resource to initiate innovation and economic growth. Such an 'opportunist' politics strives to interconnect various social problems of an ageing society with the supposed panacea of (digital) technology. It is this political rationality of interconnecting that poses analytical challenges, namely to grasp the conditions and modes by which those elements become interconnectable in the first place. In order to meet those challenges, I develop an *analytics of interfacing* that draws on conceptual resources from Karen Barad's agential realism and Gilbert Simondon's philosophy of open objects. Equipped with such an analytics, I will investigate practices and milieus of interfacing within three cases situated on different levels of an apparatus of innovation. Each of these empirical studies will aim to distil a particular mode of interfacing.

The first case study will investigate European innovation policy discourse and how it has evolved within roughly the past two decades. Chapter 4 departs from the observation that around the turn of the millennium both, robotics and elderly care, were virtually absent from European innovation policy discourse. It was only through the infrastructuring of particular rationalities of interconnection that these two elements have emerged and, at the same time, become interconnectable in European innovation discourse. In the course of the analysis, I identify three of those rationalities: active and healthy ageing, ambient assistance, and technological innovation. I trace and analyse their respective operation within three corresponding infrastructural milieus: First, in the work programmes of the European

Framework Programmes (from 1999-2018) active and healthy ageing shifts the focus away from biomedical approaches to ageing towards the interconnection of assistive technology and social care. Second, the 'Ambient Assisted Living Programme' established in 2008 re-appropriates discourses on assistive robotics and independent living rendering them interconnectable via a particular configuration of ambient assistance. Third, two innovation partnerships, the aforementioned SPARC as well as the 'European Innovation Partnership on Active and Healthy Ageing' (EiP on AHA), are based on the target value of technological innovation, which urges actors to re-design established care systems and partner within public-private partnerships to bring technology into society (i.e. the market). These milieus together with the respective rationalities they host articulate an *infrastructural mode of interfacing*, which is oriented towards stabilising and establishing the conditions deemed necessary for the future realisation of RobotCare.

Chapter 5 turns to the milieu of an EU funded robotics R&D project that aims to develop robot prototypes assisting the elderly in everyday tasks at home and in their communities. This case remains highly connected to the previous one but is characterised by a different kind of imperative: the project should materially test concrete application scenarios of RobotCare and demonstrate their future potential in realistic experiments of human-robot interaction. Within this context, roboticists and other participants prototype interconnections between robots, people, and a care-like environment. The tests take part in an apartment situated within an actual care facility and modelled after a dwelling for assisted living. Here, interfacing means to manage the double task of, on one hand, making integrated robot systems 'work' with elderly users in realistic environments and, on other hand, demonstrating that robots are 'viable' and 'plausible' solutions to problems in the everyday life of elderly people. In the former case, a myriad of surfaces, the test users' posture and speech, or mundane objects such as carpets, need to be adjusted *vis-à-vis* the robotic platform in order to make otherwise precarious demonstrations work. In the latter case, roboticists aim to invisibilise this mess by way of theatrical performances and by staging the confines of the apartment as adequate, 'realistic' representations of the lifeworld of elderly people. These efforts of roboticists in the lab materialise a *prototypical mode of interfacing* in that it, on one hand, takes the mess of human-robot interaction as resource for tinkering with its precarious conditions and it, on other hand, exercises performances of what it could mean to live and care in a roboticised society.

In the last empirical case study, the aforementioned imperative of prototyping robots in care goes one step further: Chapter 6 will investigate efforts within an EU funded project of public procurement to translate robots into marketable products for geriatric care. The project called

CLARC is embedded within a bigger project framework, ECHORD++, which commits itself to the task of bringing robotics industry and academia together in order to facilitate technology transfer. Challenging this self-description of the project I argue that, in fact, what happens within this context is not simply a transfer from one domain (the lab) to another (the market) but rather the extensive and mutual translation of users, their supposed needs, robots as well as roboticists. This is done through a standardised procedure called 'Public End-User Driven Innovation', in which public bodies (in CLARC's case, a Catalonian hospital) are highly involved throughout the development process. This is to interest such institutions in investing in robot technology to eventually help bring it to market and into care practice. The PDTI not only changes the above mentioned elements but *produces* them in the first place. For example, public end-users turn out to be hard to come by and if they are interested, they have requirements incompatible with what robotics can offer. They first must be convinced of the potential benefits robotics can yield and be incited to think of new, do-able needs compatible with the state of the art of robotics. Hence, this case exemplifies a *translational mode of interfacing*, where a whole milieu of elements needs to be adapted and appointed to the task of bringing care robots closer to becoming a marketable product.

In chapter 7, I will use the empirical insights from these three case studies to show the ubiquity and centrality of interfacing to the realisation not only of RobotCare as a phenomenon but also to the apparatus of innovation structuring its conditions of possibility. The infrastructural, prototypical, and translational modes of interfacing form what could be termed a new *techno-politics of innovation*. It presumes universal interconnectability of technology and society. It is thus not simply a preoccupation with technology *per se* that defines our techno-political era but rather the assertion that everything can be connected to technology. Technology nor society sit still in this techno-scientific world but rather they are constantly reconfigured *vis-à-vis* each other. The positivity of this kind of politics can thus not only be found in new visions and political programmes but rather in the meticulous and ubiquitous practices of interfacing, in living labs, hospitals, care homes, and universities. This poses the question of how academic critique might respond to this new positivity of techno-politics. Drawing again on the controversies surrounding robots in care I make a set of alternative propositions. At the heart of this critical project lies the realisation that processes of interfacing can impose themselves on their 'participants' in questionable ways. However, critics might not be well advised to re-essentialise human nature as a counter-strategy. Instead, I propose to connect an analytics of interfacing with Foucault's notion of critique. A critical heuristic more apt to the challenges of contemporary techno-politics might look for alternative ways of being interfaced and refuse others.

2. Robots in care – care in robotics: from interconnectedness to the question of interconnectability

The vision of introducing robots into elderly care is omnipresent these days[6]: Media articles, policy agendas, R&D project proposals, and scientific journals speculate about or work towards a scenario, in which interactive, assistive machines will care for the elderly. In this discourse, robots are almost naturally linked to and legitimised by the impending repercussions of demographic change (Peine et al. 2015). Here, robotics (in conjunction with other assistive technologies) is expected to remedy or at least mitigate the widening gap between a growing elderly population and the capacity of the welfare state to care for them. Robot technology's reputation to lower cost in industrial production seems to smoothly translate into the care sector and the elderly's home, where an ageing society is expected to soon show its effects. This chapter sketches the panorama, in front of which robotics and care are discussed in public discourse as well as previous studies on the subject within the field of Science and Technology Studies (STS).

For this, I will discuss three perspectives on the matter of RobotCare. The first *solutionist* position calls for a timely export of intelligent, adaptive, social robots into elderly care as a technological fix to a range of different social, political and economic problems (2.1.1.). The second *humanist* position largely repels this attempt as an act of colonisation. It fears that robots may violate or even substitute the integrity and humanity of care work (2.1.2.). Both of these perspectives constitute the dominant public discourse on this matter exhibiting considerable concurrences and limitations (2.1.3.). Finally, STS takes a third position, which criticises both of the former ones for their essentialist assumptions about care and robotics, society and technology as two ontologically different spheres. This critique rests on STS's contention that technology and society are intricately linked and should thus not be separated – neither empirically nor analytically (2.2.). Inspired by this anti-essentialist position a growing body of work applies concepts and arguments from STS to understand and investigate the ambivalent role of robot technology in care (2.2.1.) and of social practices of caring in robotics (2.2.2.). This discussion and especially the state of research in STS denotes the starting point for

[6] Here it must be noted again that the interconnections between robotics and care take various forms. While robots vary from explicitly social to more instrumental service machines, the care for elderly people also differs according to context, e.g. from the hospital via the elderly care facility to the private home. Hence, to speak about robotics and care so broadly is not to claim that both domains exist in such general terms. Rather, it denotes a starting point to enter into this heterogeneous discursive field. This is also instrumental for teasing out more general characteristics of this debate, namely, the relation between categories of the 'social' and the 'technological', the 'human' and the 'robotic'.

uncovering the ubiquitous conditions and modes, which have rendered robotics and elderly care *interconnectable*. Here, the present study centres on the phenomenon of RobotCare within European innovation politics, which yet remains understudied (2.3.). The chapter concludes with a summary transitioning to the analytical and conceptual perspective adequate for such a research focus (2.4.).

2.1. Social robot visions for elderly care: humanist and solutionist positions

Even though social robots[7] are still a rare sight in elderly care and everyday life in general, robot visions abound (Castaneda and Suchman 2014; Treusch 2015a; Suchman 2015). Not a day goes by without a news article proclaiming the imminent takeover of care work by robots or a report heralding the immense potentials of robots to solve demographic change. While of course this discourse assembles many different voices and views on the matter, the debate is dominated by either nightmarish dystopias of dehumanised, robotic care (for examples, see Pols and Moser 2009) or the hope and promises forming around robots as companions for (elderly) people's everyday life (Treusch 2015b). I call the former *humanist*, because it mobilises the assumption that care is and should remain an essentially human activity affording qualities specific to human beings. I call the latter *solutionist* similar to how Evgeny Morozov (2013) describes the belief most notably emanating from the Silicon Valley that any societal woe can and should be solved by technology. In this vein, robots are applied as technological solutions to the problem of an ageing society. In addition to either arguing for or against robots in care, both positions also comprise assumptions about robotics and care in particular, and categories of the 'robotic' and the 'human' in general. Hence, the following section provides a preliminary analysis of how robotics and elderly care are configured and distinguished in this discourse. Surprisingly, the ontological separation into society vs. technology is where these two seemingly irreconcilable positions concur.

2.1.1. The solutionist position

The solutionist position can mostly be found in policy documents (European Research Council 2015), research agendas (European Robotics Research Network 2004; European Robotics Technology Platform 2009), university brochures (Heeren 2013), as well as in popular science books or articles heralding the "second machine age" (Brynjolfsson and McAfee 2014) or "the

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[7] As noted above, social robots are not the only robot technology envisioned to be applied to elderly care. However, the public discourse on robotics and elderly care mostly focuses on humanoid, social robots, which are seen as overtaking (parts of) care work usually done by human caregivers.

next wave of computing" (Breazeal 2014b). In order to illustrate this position for the European context I will mainly draw on examples from the 'Strategic Research Agenda' of SPARC (2013), the public private 'Partnership for Robotics in Europe'[8]. With a total volume of €700M in public and triple that amount in private investment, this entity denotes the biggest civil funding programme for robotics R&D in the world (Partnership for Robotics in Europe 2018). Here, the vision of introducing robots into society in general and elderly care in particular is legitimised by impending demographic change.

> "The percentage of elderly people in many European societies will exceed 30% by 2050. Caring for this older population will place a significant burden on a generation of younger people and on the state. Finding effective technical solutions to providing care for elderly people is one of a range of measures required to reduce the social and economic impact of this future change. Robotics has a part to play at many stages in this challenge." (Partnership for Robotics in Europe 2013, p. 61)

Statements such as these are especially attached to care robots. Whenever a media article, funding proposal, or policy paper talks about robots in care, an ageing society looms in the background[9]. In this narrative, societies in general and welfare states in particular are depicted as awaiting a deep crisis. If demographic change is not tackled head-on, a growing elderly population threatens the future of younger generations. Such an "alarmist" discourse (Katz 1992) paints gloomy images of an ageing society in jeopardy due to a growing unproductive elderly population. This is not a new phenomenon but has a longstanding tradition in Western industrialised societies[10]. However, it is rather new that (digital) technology plays such a great role in this context. Here, robotics is staged as a "universal tool" (Bischof 2017, pp. 162–163; my translation) that "has the potential to transform lives and work practices, raise efficiency and safety levels, provide enhanced levels of service, and create jobs" (Partnership for Robotics in Europe 2013, p. 3). This 'universal' potential of robots is coupled with a rhetoric claiming that robotics is on the verge of actually realising that potential. After all, "[t]he technology to achieve these benefits is being developed now" (Partnership for Robotics in Europe 2013, p. 6). This attaches an unprecedented urgency to the export of robot technology into society.

[8] The partnership has resulted from a longlasting coordinative process between the European Commission and the European robotics community. I will uncover the specific historical processes and conditions that have led to the formation of this partnership in chapter 4.

[9] My goal here is not to question the existence of demographic change. Rather, I am interested in how it serves as the backdrop in front of which robots can become a 'plausible' solution for elderly care.

[10] Stephen Katz has traced the genealogy of this discourse back to Malthusian discourses on the relation between populations and (scarce) natural resources as well as to the institutional enclosure of elderly people within almhouses at the beginning of the 20th century (see chapter 3.1.).

Policymakers are thus busy to respond to this with efforts to, for example, adjust healthcare legal regulations or to make potential users accept robots as "integral part of … [their] daily lives" (Partnership for Robotics in Europe 2013, p. 17). Thus, the solutionist narrative effectively relegates society's role in this matter to resolving "non-technical barriers to deployment and growth" (Partnership for Robotics in Europe 2013, p. 4). The rationale of exporting robots into society essentially renders robotics and society two different realms constituting different sets of (technical or non-technical) problems, where the technical issues are prioritised over the social ones. As a result, society in general and elderly people in particular are rendered merely passive recipients of the ostensible benefits of robotics (Peine et al. 2014).

Furthermore, the condition of possibility for getting robots into care, is seen as depending on a particular, novel area of robot development, *social robotics*. Social robotics denotes a subcategory of robotics. It has emerged in the course of the 1990s and 2000s based on an alternative view of artificial intelligence (Dautenhahn 2007) and an extended disciplinary spectrum comprising i.a. psychology and philosophy (Meister 2014, pp. 110–115). This approach sees artificial intelligence as embodied, that is, as rooted not in the logical, abstract processing of information but in the interaction with the material respectively social world. The ideal case for this is human intelligence, which also evolves in constant interaction with its environment. Thus, the ultimate mission is to try to emulate or model human intelligence in machines. Consequently, social robots' ability to interact with human beings and natural environments is based on the translation of human-like capabilities into the machine[11] (like perception, walking, grasping).

One particularly prominent and recent ambassador of this project is Cynthia Breazeal, who started to build social robots in the 1990s at the MIT Media Lab and launched a crowdfunding campaign in 2014 for the "world's first family robot" called JIBO (Breazeal 2014a). This robot was inscribed with a particular design vision that underlies much of robot development for elderly care.

> "Technology can feel dehumanizing. Technology often demands that we think and act more like machines to use it. It treats us like technology, beeping, buzzing, and pushing data and information at us without concern for politeness. (…) We need to humanize technology so that it treats us the way we want to be treated. (…) My vision is that: (…) Elders will be able to age

[11] At the same time, this view is based on a 'machinic' view of what constitutes a human. The human is essentially conceptualised as a computer, see Turkle 2005, pp. 247–278.

> independently in their homes with the help of a technology that feels much more like an attentive companion than yet another digital tool or a "Big Brother" monitoring system, relieving pressure on oversubscribed institutions, and remain emotionally connected to their families and loved ones despite distance." (Breazeal 2014b)

At first glance, this statement seems to challenge the solutionist narrative of viewing robot development as a purely technical question. Even more so, it seems to make an almost humanistic critique of robotics. (Robot) technology has hitherto been 'dehumanising' for people, forcing them to use them on technology's terms. In order to remedy that deficiency, roboticists need to equip robots with 'human-like' qualities, such as the ability to be 'polite' or 'emotionally connected'. However, by identifying the social with emotion or politeness, it reproduces oppositional definitions of what is 'human' and what is 'robotic' (Suchman 2007, pp. 238–240). In other words, by claiming that social robotics 'finally' humanises technology, it actually keeps the robotic and the social apart, since it equates the social with the human and, consequently, the robotic with the non-human (and, incidentally, the non-social). As if industrial robots and machines had no connection or were not imbued with social or political qualities (Fleck et al. 1990; Akrich et al. 2002a, pp. 196–197; Winner 1980, pp. 124–128). Additionally, social robotics views the task of 'humanising technology' as solely the technical task of engineering those capabilities in robots on the grounds of a "next wave of computing" (Breazeal 2014b) giving rise to a "new generation of autonomous devices and cognitive artefacts" (Partnership for Robotics in Europe 2013, p. 4). Here, the sociality of robots does not lie in the interaction with humans but is primarily depending on technological capabilities located inside the systems of sensors, circuits, and algorithms (for a critique of this, see Šabanović 2010b; Alač et al. 2011). Hence, social robotics in particular and the solutionist narrative of robotics in general essentially leave the assumption intact that robots and people, technological and social problems belong to different ontological categories.

2.1.2. The humanist position

While the solutionist narrative paints a heroic picture of social robots in care solving the impending ageing crisis of contemporary societies, the humanist position argues for the contrary. This position is mostly critical of the possibility and ethics of social robots in (elderly) care. It can be found in numerous contexts, for example, in caregivers' views of assistive technology (Saborowski and Kollak 2015), in debates of technology assessment (van Est 2014), and nursing ethics (Vandemeulebroucke et al. 2018; Sparrow and Sparrow 2006). In the following, I will sketch out this position but not give a complete overview of critical approaches to the vision of social robots in care. Rather, what I call the humanist position denotes a more general feature that underlies a range of different critical responses. Here, the possibility that social robots might, one day, care for the elderly provokes nightmarish images of a literally dehumanised care.

> "The number and strength of our intuitions about this possibility can be gauged if we imagine a future aged-care facility where robots reign supreme. In this facility people are washed by robots, fed by robots, monitored by robots, cared for and entertained by robots. Except for their family or community service workers, those within this facility never need to deal or talk with a human being who is not also a resident. It is clear that this scenario represents a dystopia rather than a Utopia as far as the future of aged care is concerned." (Sparrow and Sparrow 2006, p. 152)

The humanist narrative thus sees the complete robotisation of care as the ultimate realisation of RobotCare and as in itself dystopian. Additionally, it questions the technological possibility of robots acting or behaving similar to humans. They "are clearly not capable of real friendship, love, or concern – only (perhaps) of their simulations" (Sparrow and Sparrow 2006, p. 154) while, in turn, defining this as the foundation of care by people. If at all, robots can create a 'fake' illusion of what it means to be human and what it means to care for humans. The effort to build social, human-like machines is thus presented as an act of deception duping elderly people of robots' 'real' ontological status (Sparrow and Sparrow 2006, pp. 155–156). As this example shows, the humanist response to (especially social) robots in care refers to the limited state of the art of robotics while extrapolating from it a pessimistic view on whether roboticists are able to follow up on their promises at all. Such arguments rest on ontological assumptions about what robots can and cannot do. They are not new. Already in the 1970s philosopher Hubert Dreyfus famously challenged the beginning optimism around artificial intelligence and what artificially intelligent systems might be able to do in the future (Dreyfus 1972). Dreyfus proposed the argument that humans dispose over a range of different capabilities, which are unique to them and, hence, unattainable for artificial intelligence[12]. In the case of elderly care, we can see similar boundary work in place.

Here, elderly care is identified as being centred around "emotional labour" by and "meaningful communication" with humans (Sparrow and Sparrow 2006, p. 152). The inherent logic and value of care derives from the mimetic ability of human care workers to attain to the human other (Hülsken-Giesler 2017). In turn, it is assumed that robots will never be able to provide such qualities since they are restricted to repetitive, rationalised activities. Pols and Moser

[12] Nearly four decades later, it turns out that it is precisely the tasks Dreyfus imagined as non-automatable (expert knowledge, logical thinking), to be the ones, where artificial intelligence seems to be most successful. As is witnessed by the immense proficiency of computer programmes in games like chess, Go, or StarCraft.

(2009) have suggested that such oppositions follow a register of temperature. Here, care is identified with (human) warmth while robotics is seen as cold and emotionless. In this narrative, machines are deemed not fit for socially meaningful work of care, because they cannot 'really' care or feel for people – an expression of their 'robotness'. By contrast, human caregivers can empathise with and express 'real' feelings for elderly people – an expression of their 'humanness'. In this sense, computers and robots embody a particular instrumental, machinic logic that is incompatible with and rival to the mimetic, 'human' care work (Hülsken-Giesler 2017, p. 163). Any attempts to bring robots into the realm of care thus bear the risk of colonising that essence of care, a "part of our humanity" (van Est 2014, p. 69). Relations with robots in particular and with technology in general thus always bare a cost at the expense of 'real' social relationships (Turkle 2011).

This does not mean that the humanist position sees no possibility at all for robots to be introduced to the realm of elderly care. However, this is deemed ethical only under particular conditions, namely, that robots may never substitute human caregivers. Consequently, in such debates robots are relegated to 'inferior', assistive tasks where they cannot substitute what human caregivers 'really' do, that is, 'warm', emotional care work.

> "Our concerns about the negative impacts that replacing human carers with robots might have on the quality of care leave open the possibility that robots may have a useful part to play in roles where they operate to assist human workers without any danger that they may replace them. In particular, the use of robotics to assist human carers accomplish such tasks as the lifting and turning of bed-bound residents, and the carrying of meal and medication trays, might improve the quality of care available to frail older persons as long as it did not lead to a reduction of the number of staff or hours dedicated to their care. Unfortunately, we suspect this caveat to be a significant barrier to the ethical use of robots in aged care." (Sparrow and Sparrow 2006, p. 153)

It can be noted here that the humanist position also operates under the assumption that robots would actually replace care workers, giving rise to a care regime where elderly people "are washed by robots, fed by robots, monitored by robots, cared for and entertained by robots" (Sparrow and Sparrow 2006, p. 152). Such a dystopian outlook is deemed problematic, not only because robots cannot treat elderly people as human beings can but also because robots are suspected as serving ends foreign to care. In this context, robots are seen as the spawn of an economised, rationalised system, which values interests of profit over real affection and care. Thus, the application of robots becomes suspicious, because such machines are seen as potentially treating elderly people and, incidentally, care givers as means to those rival ends (Vandemeulebroucke et al. 2018, p. 19).

Those risks can only be mitigated by restricting the use of care robots to instrumental, 'cold' parts of elderly care. Here, robots should only be admitted if they can assist caregivers in otherwise repetitive, physically straining tasks, for example, "the lifting and turning of bed-bound residents, and the carrying of meal and medication trays" (Sparrow and Sparrow 2006, p. 153). Consequently, this renders parts of care work literally robotic in the sense that they are easy or unimportant enough to be overtaken by machines. So, the degradation of the robotic *vis-à-vis* the human goes hand in hand with a devaluation of machinic, repetitive aspects of care work (Bose and Treusch 2013). The fact that such activities can be central to the delivery of social support (Pols 2012, pp. 34–37) or that post-social relations with objects can be very complex (Knorr-Cetina 1997) remains invisible here. The distinction between the robotic and the human reproduces the initial representation of care as being absorbed in purely human, warm qualities and capabilities, while other tasks remain peripheral to this. Hence, while the humanist position is able to accommodate the idea of introducing robots in elderly care, it does so by internalising the essentialist distinction between the robotic and the human – and in doing so devaluing parts of itself.

2.1.3. Surprising concurrences and their limitations

At first glance, the solutionist and the humanist position seem irreconcilable. While the former attaches hope and unprecedented urgency to the timely export of robot technology into elderly care, the latter sees this as an attempt to instrumentalise care for ends foreign to it. In this context, the defining feature of this phenomenon, which distinguishes it from other (no doubt numerous) technological projects in care, might lie in the way robotics imbues its produce with humanistic qualities. No other project of assistive technology (such as the smart home or ambient assisted living) seems to threaten the human core of care as much as the aspiration of robotics to engineer those qualities into machines. In turn, no other application area seems to incite roboticists as much as to demonstrate the ability to construct robots able to care for the elderly.

However next to or, rather, as a result of this opposition, both narratives concur in a number of ontological assumptions, namely, the separation of care and robotics into inherently different spheres. This is done by distinguishing either technical and social aspects in robot development or by opposing particular robotic and human qualities in care work. Additionally, both positions root their arguments in the deterministic idea that robot technology forces its effects onto society, and respectively, in elderly care. Such effects may be seen as beneficial or immoral but it is still assumed that robots will have those effects unmediated by anything else. This becomes especially visible in discussions around the substitution of care work. Users and their lifeworlds are not deemed to play a decisive role in this process. It is rarely acknowledged that under particular circumstances robots or other technologies might mediate ‘warm’ qualities of care work (Pols 2012, pp. 34–37) or that robots might yield completely different, counter-productive effects than simply raising efficiency in care work (Pols 2012, p. 131).

In pointing to the similarities of both narratives and their more or less tidy separation of the robotic and the human, the social and the technological, I do not argue that they are strictly the same or that they are necessarily false. After all, robots may have beneficial or harmful effects for elderly care. However, a first lesson from these comparisons is that both narratives offer a very limited set of options in both understanding and responding to the socio-technical challenges of robots in care – however they may look like. While solutionist narratives simply suggest to mobilise acceptance and, effectively, adapt society and regulatory frameworks to robot technology (for example Ford 2015, pp. 249–280), humanist narratives advocate for safeguarding elderly care against the ‘cold grip’ of robotic machines. The former hopes to ‘save’ elderly care from demographic change. The latter erects ethical stop signs defending the imminent invasion of robots into care. In short, both positions underestimate the *socio-technical interconnectedness* of robotics and care. For the most part, they entrench their respective agendas in essentialist assumptions about what counts as ‘really’ human or robotic.

2.2. Socio-technical interconnectedness: STS’s anti-essentialist position

By contrast, STS[13] follows a tradition of criticising and opening up essentialist understandings of technology and society. For instance, Latour (1993) has challenged the idea these denote disparate ontological realms. He ascribes the separation of the social (as something human) and the technological (as something non-human) to the self-declared ‘moderns’, who since the enlightenment have invented and reproduced that divide. This modernistic constitution stipulates that technical and natural scientists deal with relations between non-human, material objects as they are, while social scientists occupy themselves with constructs of human culture.

[13] When speaking about STS, I talk about a recently consolidating, interdisciplinary field (see Doing 2008), which centres its empirical and conceptual attention on issues at the intersection of science, technology and society. The field holds various different perspectives having originated from the sociology of science, anthropology, history,, philosophy and many more. STS is not a monolith but rather resembles a constantly evolving multitude of different threads, which curl around similar issues. This means that, when speaking about STS’s ‘anti-essentialist position’ in this chapter, I mostly refer to two prominent figures within the field, Bruno Latour and Donna Haraway. Both of whom take prominent positions within the field and have greatly contributed to the field’s popularity beyond its academic confines. So, when speaking about ‘STS’, I mean a particular ‘anti-essentialist’ part of it, which is not identical but, as I argue, representative of the broader field.

Against this, Latour argues that rather there are no solely technological or social phenomena but that the world consists of hybrid interconnections of both qualities (Latour 1991, p. 110). This is a critique of the technical and the social sciences alike as both hold on to this division of labour (the latter clinging onto a purely human, non-material idea of the social). To the same degree, a STS position à la Latour would challenge both the assumption that robots are purely a matter of technology as well as that elderly care is solely a matter of humans. Paradoxically, it is the moderns themselves, who have proliferated those hybrids. They have cultivated the planet, technologically enhanced human capabilities, and re-engineered their 'natural' habitat (Latour 1993, pp. 49–51).

Another protagonist in this vein is Donna Haraway, who has given an influential account of this increasing hybridisation and its consequences at the end of the twentieth century. In her 'Cyborg Manifesto' (Haraway 1990) she uses the cyborg, a hybrid organism of machine and human, as a speculative trope, through which to deconstruct the modernist separation of the human and the technological but also to reconstruct the conditions under which (feminist) imaginations and interventions of the cyborg may exist and proliferate. She calls for a critical socio-technical approach to re-think and (partly) resist this intensifying interconnectedness between the social and the technological. Hence, the cyborg materialises an ontology as well as a kind of politics, through which one can subvert and deconstruct the polarised orders of power.

> "The cyborg is resolutely committed to partiality, irony, intimacy, and perversity. It is oppositional, utopian, and completely without innocence. No longer structured by the polarity of public and private, the cyborg defines a technological *polis* based partly on a revolution of social relations in the *oikos*, the household. Nature and culture are reworked; the one can no longer be the resource for appropriation or incorporation by the other. The relationships for forming wholes from parts, including those of polarity and hierarchical domination, are at issue in the cyborg world." (Haraway 1990, p. 151)

Despite their differences, Latour and Haraway argue for a perspective to understand the *socio-technical interconnectedness* of human culture and to take it as the starting point for the social study of science, technology, and society. Scholars that work on technology in elderly care and on social robotics have been inspired by this strand of STS to rethink established essentialist categories in contemporary solutionist and humanist discourse. As a result, scholarship in this vein has attended to the socio-technical interconnectedness of care and robotics. For instance, Alexander Peine and Louis Neven draw both on cultural gerontology and STS calling for the analysis of the relationship between technology and ageing not in terms of solutionism (which they call 'interventionism') but in terms of co-constitution (Peine and Neven 2019). Similarly, Lapum et al. argue that technology and person-centred care are not opposed but rather intricately entangled in a "liminal space" in between (Lapum et al. 2012). Furthermore, STS inspired work on social robotics has argued for an extension of what is considered 'the social' in social robot development towards a perspective including embodiment (Alač et al. 2011), culture (Šabanović 2010a, 2010b) and social roles (Meister 2014).

Along those theoretical propositions, this section will give an overview of two strands of STS inspired research that has dealt with robots in care, that is, studying the interactions between robots and their manifold users (2.2.1.), and with care in robotics, that is, studying the role of care in robot development (2.2.2.). On the one hand, STS research in the former vein on robots' effect on actual care practice is still scarce, because there are only a few applications on the market that are used in elderly care at this point in time. Such studies mostly focus on the pet robot PARO, which is used in dementia care. Additionally, there are comparable studies on telecare technologies. On the other hand, research dealing with the role of care in robotics has focused on the epistemic culture and practice of social robotics, most notably, with regard to the question of how 'human sociality' is configured as an epistemic category. More closely linked to elderly care, such research also focuses on the role of care as an application scenario within robotics and the herein imbued representations of users in robot development. All these different strands of research are not solely situated within (Feminist) STS but adjoin other neighbouring disciplines, such as, nursing philosophy, sociology of knowledge, cultural gerontology and many more. However, a common theme in this body of literature is that it responds to the claims and assumptions made in solutionist respectively humanist narratives and that it (more or less) roots its responses in the theoretical tenet that both, robotics and care, denote essentially *socio-technical* phenomena.

2.2.1. Robots in care: the ambivalent role of 'the technological'

The first strand of research focuses on the effects of robots in care arrangements and practice. Here, the interplay between robotic devices, care professionals, elderly people, institutions of care and models of professional action is at stake. Research in this vein deconstructs the opposition between (robot) technology and care work arguing that robots can become mediators of (warm) care (2.2.1.1.). Such scholarship also responds to deterministic claims, according to which robots will simply replace care personnel and essentially erase human aspects of care work (2.2.1.2.).

2.2.1.1. *Robots as mediators of care*

A first set of studies revolves around the ambivalent role of robot and telecare technology in care practice. This body of research challenges the claim that elderly care is mainly about social and genuinely human qualities, while, in turn, robots are unable to have such qualities and, thus, cannot do care work. Against this narrative, a range of studies inspired by STS argues that technology has always been, in one form or another, a constitutive part of care, which means that also cold, instrumental aspects do not lie outside but at the heart of care practice (Pols 2012, pp. 34–37). Studies also show that especially robotic technology can mediate and be target of 'warm' aspects of caring relations . Even more so, in order to achieve 'good' care, designers as well as users (need to) work towards fitting warm and cold qualities of care relations.

While in theory technology and care are often set in opposition, in practice technical artefacts like wheelchairs, electric beds, or X-Ray machines have since long been part of care arrangements (Mol et al. 2010b, pp. 14–15). Due to ongoing trends of digitisation , this presence of computer technology in care has significantly increased in the past 20 years and is expected to continue to increase in the future (Korhonen et al. 2015). Recent examples for this trend are computer-aided documentation systems (Hülsken-Giesler 2008; Tolar 2010), ambient assistive technologies (Neven 2015; Krings and Weinberger 2017), telecare devices (Pols 2012; Oudshoorn 2011) and, in some cases, robot pets in dementia care (Pols and Moser 2009; Pfadenhauer and Dukat 2015; Neven and Leeson 2015). Hence, the technologisation of care work does by all means not start with robot technology but rather can be seen as intensifying with the presence of service robots in socio-technical arrangements of care (Krings et al. 2014). While studies of this trend remain largely critical of the actual effects on care (for example, see Hülsken-Giesler 2017), they at the same time seek for ways to conceptually account for and accommodate technologies in nursing theory and gerontology (Mol et al. 2010a; Lapum et al. 2012; Peine and Neven 2019; Hülsken-Giesler 2008).

In their analysis of the use and role of PARO[14] in a Japanese care home, Neven and Leeson (2015) rely on two concepts by anthropologist Victor Turner: *liminoid* and *communitas*. Here, liminoid phenomena refer to the stages in tribal rituals when participants transition from one social role to the other. In this liminal phase, interactions between participants enter the mode

[14] The following studies that dealt with explicitly robotic technology investigated PARO, a socially interactive and therapeutic robot that looks like a white baby seal. This kind of robot is mostly applied in activation theory in dementia care. The system is able to pro-actively engage with users by sounds and movements but also react to touch, speech and the position, in which it is held. Additionally, PARO can communicate its systemic states by way of motor expressions, for example, by moving its head or by opening and shutting its eyes.

of *communitas*, where hierarchies and social roles are de-emphasised thus allowing people to bond beyond differences in status. This results in playful and leisure activity engendering new possibilities of social interaction. Along those lines, care professionals introduced PARO as a collective activity for the care home residents, in which the robot became a shared object among them. The use of the robots was restricted by a circulation system among residents thus rendering them "objects of desire" (Neven and Leeson 2015, p. 98). Interacting with PARO denotes a playful practice, which created a space separate from everyday life in the care home. Here, the robots were staged by caregivers as a communal focal point for the group. "As a consequence the PARO activity was formed as a social event for people who were continuously attentive and attracted to the robots" (Neven and Leeson 2015, p. 98). However, the sociality in this case was not restricted to the robot and its technical capabilities, although they played a role in keeping elderly residents attentive. Rather, this required extensive coordination and staging of social togetherness on the part of caregivers.

In another study of PARO Pfadenhauer and Dukat (2015) focus on the interaction between so-called care workers[15] and residents in a nursing home. They argue from a post-phenomenological perspective that the meaning and effects of robots do not depend on what a robot can do or does. "Rather, it [post-phenomenology; B.L.] defines technology according to how it appears to human consciousness" (Pfadenhauer and Dukat 2015, p. 394). In doing so, they focus on "the performance of the deployment of social robotics" (Pfadenhauer and Dukat 2015, p. 398), rather than on its technological or design features. More specifically, they look at how people, especially caregivers and care home residents, incorporate PARO into social interaction. In their discussion, the authors distinguish two variants of the deployment of the robot. In the first variant, introducing the robot produces an occasion for conversation either about or with the robot. Here, there is an 'alterity relation' established between robot and the elderly resident as the robot appears as acting on its own. However, this effect, Pfadenhauer and Dukat argue, is not due to the advanced capabilities of the robot but due to its "disobedience" (Pfadenhauer and Dukat 2015, p. 403), that is, due to the inability of residents to predict what the robot is going to do and when. In the second variant, care workers aim to sustain an "optional spatio-temporal communication setting" (Pfadenhauer and Dukat 2015, p. 403) between the robot and the elderly person. Here, they establish a hermeneutic relation, where the robot produces signs, for example sounds or movements, which the elderly person

[15] For operating PARO the care home in question employed 'additional care workers', which denotes a newly established line of care work with a different occupational profile. I will come back to this phenomenon in the next section.

then interprets. Care workers report that in this context PARO has the ability to open the “heart doors of memory” (Pfadenhauer and Dukat 2015, p. 403). The interaction with the robot can render residents’ ‘former’ personality visible, which otherwise remains concealed by the disease.

In their article, Pols and Moser (2009) investigate different cases of how users interact with healthcare technology. For this, they compared a telecare device, the Health Buddy (see also Pols 2012), with two robot prototypes, Sony’s robot dog ‘AIBO’ and Philips’ ‘I-cat’ deployed for research purposes in a Dutch and an American residential home for the elderly. As has been alluded to above, Pols (and Moser) argue against the strict distinction between ‘cold’ technologies and ‘warm’ care. For the case of the Health Buddy, a telecare reporting device used in palliative care, Pols argues that while technology does not have 'feelings' it nevertheless mediates 'love' and warm aspects of care. In telecare settings, such love and concern for others was expressed "*through* devices" (Pols 2012, p. 34; original emphasis) in two forms: as care for the nurses and as care for the device. The indirect nature of communication between the patients and the nurses through the Health Buddy[16] tempered concerns of the patients to interrupt and disturb in nurses’ daily work at the hospital. To report via the telecare device was a way to help the nurses and “to act like a ‘good patient’” (Pols 2012, p. 35). Furthermore, patients cared for the device itself as well. Patients spoke of the box as a ‘friend’ or a ‘pet’[17] which according to Pols “points to how the white box has itself become an ‘end’ rather than a ‘means’ (Pols 2012, p. 36). Similar to this case Pols and Moser analyse documentary material of the interaction between elderly people and the AIBO as well as the I-cat. Here, they observe that also robotic devices mediate warm qualities of care. For example, the AIBO invites play with residents by way of the relative unpredictability of its behaviour. By contrast, the I-cat device forces users to interact with it in a structured dialogue not able to account for inputs that did not follow the standardised protocol. Concluding these empirical examples, Pols and Moser argue that

[16] A white box with a simple keyboard interface to answer questionnaires or send for help. Telecare technologies such as the Health Buddy denote an additional class of technologies, which are not directly linked to robotics Studies on telecare are comparable, because they elicit affective and social relations in similar ways as robots do, see Pols and Moser 2009. Moreover, they are comparable because robotics has heavily inscribed itself into the vision of telecare, promising novel channels of communication and interaction at a distance, see Wagner 2009. Hence, studies of more conventional telecare technologies serve as proxies especially for evaluating the effect of robotics *vis-à-vis* care on a more organisational level.

[17] This also is a common phenomenon in robotics. Even rather ‘lifeless’ looking robots such as mine sweeping robots, see Carpenter 2013, 2016, or cleaning robots, see Sung et al. 2007, seem to afford intimate and personal relations with their users.

> "[w]arm and cold, rational and affective, medical and social, technological and sociable are not opposites, but are aligned in different ways in different practices. How connections are made depends on who the users are, the possibilities the technology brings, and result from the way in which all the elements interact. Hence, alongside analysing design processes, it remains crucial to learn about these possible connections by observing use practices. Such analyses will reveal different ways of complying, folding different needs and values together, rather than either complying or not." (Pols and Moser 2009, p. 176)

Taken together, these studies show how the use and deployment of (social) robots and other healthcare technologies are embedded within practices of caring and staging. PARO's effects in dementia care are mediated by the particular way caregivers introduce and coordinate the interaction with elderly residents of care homes. Although the technical design of robots makes more or less a difference in their acceptance and effectiveness but, in the end, this depends on their performance with people in socio-technical care arrangement *in situ*. Against the deterministic assumption that robots dehumanise care, this line of research argues that

> "[t]his makes it impossible for 'robots' to have one clear and unequivocal effect on 'older people' as both categories are grossly oversimplified in such reasoning. (…) [W]e would do well to trade in simple deterministic views for a more complex understanding of the way in which older people and social robots shape and give meaning to each other." (Neven and Leeson 2015, pp. 99–100)

Coming back to Pols and Moser's distinction between cold and warm aspects of care, the issue of technical artefacts in care is not a question of separating the two along those distinctions but rather about creating fits between warm and cold components of 'good caring' (Pols 2012, p. 39).

2.2.1.2. Robots and socio-technical arrangements of care

Next to interactions between users and robots, studies investigate the role of robots in socio-technical care arrangements (Krings et al. 2014) with regard to their impact on professional roles and the organisation of care work. This strand of research responds to the solutionist hope and the humanist fear that robots will raise (cost) efficiency of the delivery of care by displacing human care work with technical devices. Against this view, these studies have shown that the introduction of robotic devices into care arrangements actually produces more (human) work and shifts existing distributions of labour within care, rather than replacing it altogether. Hence, robots definitely have effects but such effects are mediated by the particular socio-technical as well as organisational conditions of care and, thus, often do not conform to deterministic expectations of either humanist or solutionist positions. Furthermore, such studies (more or less) explicitly point to effect of robots in care that go beyond the micro level of interactions between robotic devices and users of different sorts. Also in this line of research, which observe cases of robots in a strict sense, studies are scarce. That is why I will again use telecare as a (more general) proxy in order to flesh out the points and arguments that are already being made in research on robotics in care.

Telecare denotes the endeavour to provide care remotely. This project is commonly referred to as a solution for rural areas where medical and nursing institutions, such as care homes and hospitals, might be scarcer than in urban areas. Especially in this context but also with regard to the overall rate of hospitalisation of patients, telecare is positioned as a "technology of de-institutionalisation" (Oudshoorn 2011, p. 196), because it is deemed to allow for reducing the duration and frequency of hospital stays. However, Oudshoorn's study on telecare technologies and their impact on healthcare shows that

> "[i]n contrast to what advocates of telecare technlogies promise, these new devices do not reduce human labour. (…) The implementation and use of telecare technologies for heart patients implies that more actors are becoming involved in healthcare, including cardiologists, heart-failure nurses, general practitioners, home-care nurses, telenurses, telephysicians, health insurance companies, telemedical firms, and, last but not least, patients." (Oudshoorn 2011, p. 190)

Oudshoorn shows how these new actors become enrolled into regimes of telecare engendering new struggles and boundary-work on the part of the involved professions (especially, the yet 'non-professional' group of telenurses), and new responsibilities and obligations on the part of patients to become "inspectors of their own bodies" (Oudshoorn 2011, p. 194). While, on the one hand, telecare extends and decentres the clinical gaze to non-professionals (e.g. telenurses and patients) and a vast network of surveillance technologies, on other hand, the diagnosis and therapeutic decision-making process remains firmly in the hands of medical professions. So, Oudshoorn argues, in concentrating the power of decision making within the medical profession and in technical devices, the clinic is re-centred, that is, re-institutionalised.

Pols' study of telecare (2012) shows that new routines introduced by the telecare system were heavily depending on old routines. For example, in order to be able to interpret the various codes and signals attached to individual patients, nurses have to rely on knowledge based on their previous experience or *ad hoc* improvised strategies. Also, new routines (such as dissecting 'false-positives' from real problems) result in more work for care personnel, as the new technology also comes with new problems. This obviously clashes with the notion of efficiency introduced by the project's developers. "Attempts at rationalisation may interfere with efficiencies in current practices, creating a mess rather than efficiency" (Pols 2012, p. 131).

So, in summary, Pols argues that robotic telecare devices are in any case interfering with existing routines and can disrupt efficiencies already in place. The point Pols' study renders available here, is not that technologised routines should be kept out of elderly care but rather that technologisation "demands more respect for existing routines than is common in innovation practices" (Pols 2012, p. 131).

The previously described research on the actual use of social robots in care makes similar points about the actual use of social robots in care. Those studies can also be read as accounts of how the introduction of care robots creates additional work and, in the case of Pfadenhauer and Dukat (2015), robots may even support new forms of care work. First of all, the two studies described before (Pfadenhauer and Dukat 2015; Neven and Leeson 2015) give accounts for how social robots are not simply 'put' into care arrangements but need to be staged and managed in particular ways. Neven and Leeson's argument about *communitas* shows this nicely. The use of social robots in dementia care denotes a collective activity that afforded care workers to establish a circulation system among residents in order to manage such robots as "objects of desire" (Neven and Leeson 2015, p. 98). 'Using' a social robot in care required additional staging work by care givers, which otherwise would have not been necessary (that is, without social robots as part of the care arrangement). Robots did not work by themselves thus rendering care personnel disposable but rather they required novel techniques by caregivers in order to render them a social focal point for the group.

In a similar way, Pfadenhauer and Dukat (2015) show how the implementation of social robots into activation therapy has enabled the introduction of additional, lower skilled care workers. As alluded to above, the deployment of social robots was conducted not by the 'professional' care personnel but by 'additional care workers', which denotes a rather new occupation acknowledged by Austrian social legislation. In general, they are employed in order to increase the quality of care and life in facilities of dementia care – always in close collaboration with nursing staff. In the case of the deployment of PARO, they took charge of the aforementioned tasks introducing residents to the device and instructing their use. According to Pfadenhauer and Dukat, the presence of such additional care workers can create conflicts, "in which the young occupational field of professional caregiving and activating must assert itself against the long-standing profession of nursing." (Pfadenhauer and Dukat 2015, p. 404). However, this also holds potential for further professionalisation of such nascent occupational fields, which lies precisely in the use of (robot) technology to tackle crises in interaction with dementia patients.

To conclude, this line of research points to additional care work afforded by the complex use of robots in practice as well to inefficiencies arising within the interplay of technological innovation and existing routines in care. Again, the introduction of robots into care does not simply replace human caregivers but rather robots become part of socio-technical care arrangements shifting professional boundaries and responsibilities. It remains to be seen how exactly potentials and conflicts of professionalisation will play out in the future. However, it can already be noted that care robots such as PARO respectively tele-robots "will evidently not only create new human-robot interactions, but will also change the organisational setting in nursing homes with respect to workload, work description, and hierarchies" (Meister 2014, p. 113).

2.2.2. Care in robotics: the ambivalent role of 'the social'

The second strand of research focuses on the role of human sociality as an epistemic category and elderly care as an application scenario for robot research[18]. Studies in the former strand strive to extend and situate accounts of the social in social robotics research (2.2.2.1.). For example, a core theme in such studies is to show the interconnectedness of particular assumptions about (human) sociality in robot design and the normative and cultural contexts in which they emerge. Research that focuses on the role of care as an application scenario in robot development renders visible the (often negative) representations of care (work) and elderly people in robot development as well as their embeddedness within normativities of contemporary political discourse (2.2.2.2.). Such studies mainly criticise ageist assumptions about what elderly people need as well as their exclusion from robot development. Again, this strand of research responds to the essentialist and deterministic presuppositions in humanist and, especially, solutionist narratives. For instance, they criticise roboticists' reductionist models of the 'social' and their disregard for elderly users' and caregivers' views on the usefulness of robots. While the first set of studies argues for a more interconnected view on human as well as machine sociality, the second set of studies argue for more participation of elderly users and caregivers in robotics projects.

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[18] Just as in the case of the previously discussed strand of research, STS scholarship on the role of care in elderly care is scarce despite its popularity in innovation discourse and R&D practice. That is why in this review I will at times also resort to research on similar assistive technologies related to care (e.g. ambient assisted living). I justify these analogies by the embeddedness of these technological projects within similar politico-normative discourses (e.g. on independent living) and thus similar conditions for their application-oriented development.

2.2.2.1. Human sociality as epistemic category

The first set of studies attends to the design of humanlikeness and sociability in robots, which are positioned as pre-conditions for interacting with human users and caring for elderly people (see the solutionist narrative of social robotics in section 2.1.1.). Here, the focus lies on how social robotics discursively and materially configures the ‘social’ respectively the ‘human’ in robots. This research interest responds to the solutionist narrative’s assumption that making robots social can only be achieved by engineering machines in the image of humans. Here, STS studies of robotics visions and practice point to historically contingent accounts of humanness and to the fact that cultural assumptions heavily influence robot design. Additionally, research in the tradition of laboratory studies has investigated the material epistemic practice of roboticists in the lab. The laboratory has established itself as the central site where ‘the social’ in robotics is standardised, measured, and constructed. However, social robotics also introduces new complexities into the engineering of machines, for example, by deliberately demonstrating robots in real world environments. As a result, this strand of research points to the ambivalent role of the social in social robotics: On the one hand, it retrenches traditional and rationalistic images of humanness and reduces ‘the social’ to a measurable variable and an engineerable component. On other hand, building machines that exhibit humanness and interactive agency also works to extend existing imaginations of the human and the machine towards a perspective that acknowledges the close interconnectedness of both categories.

In ‘Human-Machine Reconfigurations’, the second updated version of her 1987 book ’Plans and Situated Actions’ (Suchman 1987), Lucy Suchman adds four new chapters that deal with the renewed boom of the project of humanoid machines from the 1990s onwards (Suchman 2007, 206-286). She investigates the imaginaries of and assumptions about personhood that underlie discourses in social robotics and AI (Suchman 2007, pp. 226–240). Here, ‘sociable’ machines come into being through socio-technical practices in the laboratory and staging techniques such as demonstration videos (Castaneda and Suchman 2014). For example, to engineer the capability for machines to recognise and exhibit emotional cues, roboticists required (and hired) test subjects to produce clearly distinguishable emotional states. Thus, in order to ‘render machines emotional’, humans had to adapt their emotional behaviour to the machine in the first place. However, such human-machine reconfigurations and the efforts that go into them are erased in claims about and representations of robots becoming human-like (Suchman 2007, p. 217). Hence, the claim of social roboticists like Cynthia Breazeal to humanise technology is not simply a technical task to ‘put’ emotion into machines as it is. Rather, this involves the socio-technical and mutual reconfiguration of machines and robots.

Following the Feminist, situated perspective of Harraway (1988), Suchman fears that the erasure of the socio-technical complexities of social robotics will fetishise humanoid machines and “retrench, rather than challenge and hold open for contest, received conceptions of humanness” (Suchman 2007, p. 239).

In the same vein as Suchman, Šabanović (2010a) compares the culture of social robotics in Japan and the United States and, more specifically, cultural models of sociality and affect. In doing so, she shows how cultural practices and models impact on the design of robots and on user’s responses to robots, and how they vary across different “robot cultures” (Šabanović 2010a, p. 1). Drawing on sociological and psychological theories she distinguishes the US American and Japanese culture according to different notions of the self: independent vs interdependent. In each culture the individual is confronted with different expectations, for example, the display of emotion (explicit vs. implicit). Robot designs, Šabanović argues, materialise such cultural models in that they reflect the notion of self associated with the cultural milieu from which they originate. With regard to the engineering of ‘affect’ in robots, she observes that Western designers tend to render emotions explicit in robots. For example, many robots exhibit animated eyes, lips or tongues, which should express particular emotional states. Here, affect should be represented in the robot. By contrast, Japanese roboticists design emotion in a much more implicit manner emphasising the reaction of the human counterpart rather than an intrinsic emotional state. For example, the faces of *karakuri ningyo*, Japanese mechanised puppets, were designed rather neutrally allowing their audience to interpret different emotional states depending on the observer’s orientation.

While the former two studies mostly focus on the discursive representations of ‘the social’, Alač (2009) confronts those with the epistemic practices of social robotics in the laboratory, especially with regard to questions of social interaction and embodiment. In her ethnographic study, she analyses the multiple interactions between a robotic body and the bodies of two roboticists, who try to design robotic movements by training the robot through their own bodies' movements. The human body functions as an instrument or model for robotic humanoid movement. However, Alač argues, this does not only involve the reconfiguration of robotic behaviour but also, conversely, the adaption of human behaviour *vis-à-vis* the computational limitations and possibilities of the robot. Embodiment is enacted in the continuous interaction and reconfiguration of human *and* robotic bodies.

> "To be designed, social robots require complex reconfigurations of human bodies, as scientists, to master the skills of social robotics and accomplish their work, employ the robotic technology as a part of themselves.” (522)

Alač concludes by arguing that the common notion of 'extension' of human capabilities via technology must be reconsidered *vis-à-vis* the phenomenon of social robots as these technologies "talk back, demanding from us to reconfigure ourselves in the opening to the world" (522) (Alač 2009).

To date, Bischof (2015, 2017) offers probably the most extensive analysis of epistemic practices in the field of social robotics. Here, he is interested in how roboticists design, build, and do their research via social robots. Referring to Rittel and Webber (1973) he argues that for roboticists sociality means a 'wicked problem', that is, the problem of coupling the abundant complexity of social situations with the engineering of machines. Roboticists deal with this mainly by reducing complexity in the environment by, on the one hand, *abstracting* concrete situations as scenarios and, on the other hand, by *integrating* robots into such concrete situations in the laboratory. Here, the laboratory has established itself as *the* central site of knowledge production in the field of social robotics (Bischof 2018). In this context, Bischof distinguishes three different epistemic strategies, through which roboticists operationalise and construct the 'social' in laboratory experiments (Bischof 2015, pp. 307–311). They do so (a) by standardising and measuring the effects of human-robot interaction, e.g. in controlled laboratory experiments, (b) by way of everyday non-scientific heuristics *vis-à-vis* the users and their life-worlds, e.g. through empathy towards elderly people or biographical experiences, and finally, (c) by staging the robots and their 'social' capabilities, e.g. through video clips or demonstrations. While practices of laboratorisation certainly reduce the complexity of the social, Bischof does not see this as necessarily expressing a 'cold' or 'reductionist' epistemic culture distorting the 'real social' but rather as pointing to a constant feature of social and epistemic practice in general. Hence, such reductions of complexity relate to affordances of a specific social activity, designing robots, namely, to render social situations available for computation. Furthermore, Bischof argues that social robotics also re-introduces complexity, namely through non-scientific heuristics or demonstrations in environments outside the laboratory. Instead of viewing social robotics merely as an endeavour to reduce the complexity of the 'social', he compares its epistemic culture to the movement of a pendulum swinging back and forth between the reduction and re-entry of complexity (Bischof 2015, p. 316).

This re-entry of complexity becomes apparent when investigating how social robots do achieve social agency in designated contexts of application. Here, Alač et al. (2011) studied a case in a pre-school setting, where they observed how roboticists and other participants collectively coordinated human-robot interaction (Alač et al. 2011, p. 894). It is this coordination, they argue, which enables robot technology to become social. In this context, Alač et al. point to multiple instances where the pre-school setting challenged controlled models of sociality discussed above. On the one hand, roboticists had to laboriously rearrange instruments and people in order to render social human-robot interaction observable thus establishing an order similar to the laboratory (Alač et al. 2011, p. 918). On the other hand, the pre-school was not simply an extension of laboratory space but rather roboticists' experiments and control efforts were continuously resisted and inflected by local organisational routines. Thus, the pre-school also changed the epistemic practice of the roboticists altering their assumptions on what the 'social' is. In this sense, the sociality of robots not only resided in the machine itself but extended towards the spatial arrangement and interactional coordination. This also involved the interactional counterparts of the robot, the pre-school children whose responses to the robot were of great importance for the operation of human-robot interaction. The roboticists had to be sensitive to the social and spatial positioning of the children and the "intersubjective life-world" (Alač et al. 2011, p. 919) inhabited by the children, the teachers and the roboticists themselves. In conclusion, Alač et al. state that "robots become legible as social actors in relation to careful interactional engagements and the spatial arrangements of people and things" (Alač et al. 2011, p. 920) thus confronting robot design with the complexities such engagements hold.

To summarise, this strand of studies points to the ambivalent role of the social in social robotics: On the one hand, it retrenches traditional and rationalistic images of humanness and reduces 'the social' to a measurable variable and engineerable component. On other hand, in building machines that elicit humanness and interactive agency social robotics also works to extend existing imaginations of the human and the machine towards a perspective that acknowledges the close interconnectedness of both categories. As Alač puts it, robots afford different forms of engaging with them since they confront humans as more or less (re)active counterparts (Alač 2009, p. 522).

2.2.2.2. Care as application scenario

This second set of studies from STS focuses on assumptions about elderly people and scripts of ageing that are inscribed into robot technology respectively assistive technology. Additionally, it attends to the dissuasive effects this has on actual use of robots in elderly care. Research in this vein challenges claims within mainly solutionist narratives about the inherent 'goodness' of introducing robots into care. Such discourses establish an almost natural link between robotics and elderly people. This link is criticised by STS as depending on a particular rationality of innovation, which is left unquestioned. Hence, in this research robot development does not simply develop technology but also produce social norms of care and identities of elderly people.

A first concern for studies that revolve around care in robotics centres around the deterministic and essentialist narratives and practices of roboticists attempting to apply their robots to care arrangements. Here, Šabanović (2010b) analyses the linear and technologically determinist narratives of (social) roboticists, which configure the relationship between technology and society in terms of “social impacts” and “social acceptability” (Šabanović 2010b, p. 449). In such narratives, roboticists identify technological advancements as key to determine impacts and acceptability. Robots are imagined as solving social problems while at the same time ignoring the complexities and contingencies of such social worlds. Social problems are essentially seen as technological problems. Conversely, users are seen as passive subjects who, once robots are developed, just need to accept and adapt to them. Šabanović problematises this determinist view arguing for a framework that embraces the mutual shaping of society and technology, and for its application to the design of social robots. Resorting to her own research discussed in the previous subsection, she argues that the development of social robots is heavily influenced by socio-cultural imaginaries and assumptions by designers (Šabanović 2010b, pp. 440–441). Conversely, the adoption of technology has great influence on how social problems and society at large is viewed. For example, popular culture, itself deeply pervaded by topics associated with Artificial Intelligence and robotics, can play a role in facilitating the appropriation of robot technology by users. It renders people and robots familiar with each other. This change of perspective renders necessary “a more open definition of the context of robot design, in which uncertainty, situational awareness, adaptability, and social responsibility play an important role” (Šabanović 2010b, p. 446). As a consequence, robots need to be "*evaluated in society*", studied as part of “*socio-technical ecologies*” and “*designed from the outside in*” (Šabanović 2010b, pp. 446–447). Such a perspective Also calls for an prompt participation of users in the design of social robots (Šabanović 2010b, pp. 447–449). Together with roboticists, she thus has proposed a framework of “situated robotics” (Šabanović et al. 2006, p. 577) that, by integrating the influence of social and spatial environments on HRI, would render available a broader range of alternative designs.

This is not to say that roboticists do not account for social implications of their design. However, they do so in a specific way. In his study already described in the previous subsection, Bischof (2017, pp. 198–202) reconstructs the epistemic practices associated with the particular ‘access’ of robotics to care. This access is configured by the target value of ‘application’. Here, the central motivation of roboticists to introduce care robots into settings of elderly care is to pilot a platform in certain care arrangements and to test the results according to feedback from participating care professionals. The aim of such projects is to evaluate the effect of a particular intervention (here: introducing a robot into several care homes) in a particular practice (in Bischof's case: the morning washing routine). Thus, care features in this type of practice as a testing ground for previously designed robots. This endeavour was only partly a technical matter. Before the trials could even start, roboticists had to convince and promote their project *vis-à-vis* the ministry of health, care home officials, and caregivers. Hence, researchers' work first consisted of aligning a number of different actors in order to install the political, social as well as the technical conditions for field tests to take place. Finally, such field tests also comprised representations of users. In Bischof's case, such representations were restricted to standardised scales of wellbeing. Otherwise, elderly users did not feature in scenario descriptions. Bischof argues that this is due to the universalistic pretence of such projects. Researchers' motivation were not to adapt the robot to the needs of local users but rather "the implementation of an exemplary case of application and the proof of its effectiveness" (Bischof 2017, p. 202).

Such proofs relate to specific particular political and normative expectations of what constitutes effectiveness and why developing robots is desirable at all. Here, Šabanović (2014) shows for the case of Japan's 'robot culture' how roboticists aim to create a fit between local traditions and the 'universal' values of science and technology (see also Wagner 2013). Cultural values are actively positioned as a means to both accommodate robots in everyday life as well as to legitimise their research and development. Here, the development of robots is promoted by government, industry, and academia as a "continuation of Japanese culture" (Šabanović 2014, p. 359). Šabanović takes this as a case for how culture and technology are *actively* interconnected in the discourse and practice of Japanese robotics. At the same time however, it also shows how the interconnection of culture and technology gives rise to new strategic separations (e.g. Japan as the cultural 'other' vis-à-vis the West) and essentialisms (e.g. Japanese culture as inherently robot-friendly). In the case of European innovation discourse, Neven (2015) argues that the almost natural link between technological innovation and elderly care is due to the innovation (staged as a desirable end in itself) and the moral representation of elderly people as preferring to live at home. Here, developers and researchers try to inscribe their technologies (be it robotics or ambient assisted living) into wider moral and political discourses on ageing and innovation. As a consequence, the development of such technologies is staged "as inherently good, which further aligns the involved actors around this representation of older people and the development of the technology" (Neven 2015, p. 40).

Along these lines, Neven studies the impact of ageist representations in ambient assisted living and robotics projects and their impact on (non-)use and the everyday life of elderly people (Neven 2010, 2011, 2015). Ageism refers to the negative or passive depiction of elderly people through the ascription of stereotyped qualities, such as, frailty or dependency (for a historical account of this, see Katz 1992). Here, Neven connects the concern of ageism to the STS concept of the script (Akrich 1992) in order to show how such ageist user representations become inscribed into technologies for the elderly. One of his studies focuses on the testing of a robot prototype in a Dutch firm (Neven 2010). While the company researchers responsible for these trials was firmly invested into getting to know the specific needs of elderly people, they struggled to incorporate test users' alternative views about ageing into the robot design. The basic premise of the project was that elderly users would need a health robot and also would accept it. However, elderly test users perceived the robot as being intended for old, lonely, and frail people. This perception, in part, stemmed from news coverage about the robot in the media. Test users resisted that user representation and, consequently, disassociated themselves from the robot system. They would test the prototype but not use it themselves. Researchers responded to this resistance by, amongst other things, foregrounding elderly peoples' status as test users, who are more difficult than other target groups, instead of regarding resistance as a useful indicator of what elderly people actually want. Hence, Neven argues, ageist user representations increase the risk of non-use of robots in particular and technologies for the elderly in general. He concludes by suggesting that

> "[r]ecognising and taking into account user representations formed by elder users, for instance in user tests, is important as it could help prevent ageist scripts, and resistance to and non-use of technology by elder users by charting positive and negative interpretations of the supposed prospective user of a technology. This information could then serve as input for more reflexive (re)design of technologies." (Neven 2010, p. 345)

In another case of an ambient intelligent monitoring system (AIMS[19]), he shows how this system embodied a "passive age script" (Neven 2015, pp. 40–41), which deeply reconfigured the everyday life and home of the elderly people monitored by it. For instance, once the system was installed there were limited to no possibilities for users to change how the system worked, namely, when and where they were being monitored. In the end, users were forced to 'put up' with the system to please either care personnel or relatives (Neven 2015, p. 41). Furthermore, AIMS also socio-technically reconfigured the home of elderly inhabitants in multiple ways. For

[19] According to the author the name of the system is fictitious due to the need for anonymisation.

instance, AIMS interfered with existing technologies in their home (the telephone) or generated noise and light in the night due to malfunction. Consequently, this reconfigured the people's feeling of safety in the home, because malfunctions in the home led to the disturbance of the access of emergency services. Neven concludes:

> "The central tenet of AIMS is that it aims to allow older people to remain living in their own homes and indeed, it 1ives up to this promise. However, while the older users of AIMS are able to stay at home, it is no longer the same home. It is a reconfigured and re-scripted home." (Neven 2015, p. 42)

To summarise, this line of research points to the precarious role of care in robot development. On the one hand, assumptions of elderly people and care work find their way into robot design through "roboticists' own 'conscious models' regarding human social behavior" (Šabanović et al. 2006, p. 577). These assumptions are mostly imbued with ageist representations of the elderly. On the other hand, while elderly people do increasingly feature in robot development, their contributions are either regarded as inconsequential, or simply taken as a resource to legitimise an otherwise unquestioned political agenda respectively development path (Compagna and Kohlbacher 2015; Compagna and Shire 2014).

2.2.3. STS research on robots in care and care in robotics

In this overview, I have reviewed research that focuses on either the effects of robots in care or the role of care in robotics., While both of these strands of research overlap in many ways, they put forward diverse critiques to humanist and solutionist positions. Against essentialist and deterministic arguments in these narratives, STS studies give a rich account of the socio-technical interconnectedness of robots in care and of care in robotics. Additionally, such research offers many more ways of how to shape and respond to visions and projects of robots in care. For instance, they demand more attention to be payed to the representations of care and elderly people inscribed into robot technology (Neven 2011). This could be achieved or at least mitigated to an extent by strengthening the position of potential users (including caregivers) as well as STS expertise in co-creative design processes (Peine et al. 2015).

Furthermore, by assembling all these different studies, the present overview renders available another point and preliminary result: it paints a rich panorama that gives an idea about the breadth and scope of efforts that are invested in fitting robots and older people, robotics and elderly care. Robotics and care, the social and the technological are not strictly separated intimately interconnected with one another. Rather, examples for their interconnectedness stretch over a multiplicity of ongoing practices and contexts. A first result from this is that the phenomenon ranges across various discourses (political, scientific, professional, …), practices (epistemic, caring, tinkering, …), technologies (telecare, robots, routines, …), and settings (care facilities, laboratories, the home, …). It is this broad range of research that opens up the empirical playing field of this book. In the following I will use this panorama of empirical insights and conceptual resources to launch a study of RobotCare that lives up to this ubiquity.

2.3. RobotCare and the question of interconnectability

STS scholars' insistence on pointing out the socio-technical interconnectedness of robots in care and of care in robotics denotes an essential first step towards opening up the seemingly hardened fronts of solutionist and humanist positions. The existing scholarship outlined above is instructive for uncovering and criticising the underlying assumptions of both of these narratives. Yet, it sometimes seems as if STS itself slips back into a humanist stance relying on *a priori* ideas about human-machine differences itself (Suchman 2007, p. 260; Turkle 2011). With this being said the present study endeavours to move beyond respectively add to existing research on this matter in two ways. (a) It extends the empirical scope for studying interconnections between robotics and elderly care. Instead of either focusing on robots in care or care in robotics, it centres its attention on the phenomenon of RobotCare. (b) Here, the present study does not presuppose the interconnectedness of both domains but rather attends to the (social, technical, political) processes, which have enabled robotics and elderly care to become interconnectable in the first place. For each of these movements STS offers specific resources, which will continue to underly my theoretical and analytical work.

The first movement implies to not restrict the analysis either to the domain of robotics or elderly care but rather investigate their interconnection within a particular context, in this case, European innovation politics. In other words, I argue that the empirical insights about robots in care and care in robotics need to be conceptualised as part of the same phenomenon. While studies in the former vein underline the importance and impact of (robot) technologies in care arrangements and practice, the latter strand of research points to a change in the perception and engineering of (robot) technology as social and agential. Both of these processes need to be considered together in order to grasp the complexity of factors that play into the interconnection of robotics and care. Here, it is important to note that the primary research interest of this study is not a comparative one. It will not switch between the two domains as such contrasting a certain 'third' parameter[20] but rather on the emergence of, what I call, RobotCare. It denotes a phenomenon in which both domains are still recognisable as distinct yet mutually reconfigured components of a single vision respectively project.

There are a few examples in the literature, which at least touch on this. Šabanović (2010a, 2014, 2007) embeds her analysis of social robotics within the political and cultural context of Japanese society but care only features as a marginal component amongst many others. Her analysis thus 'tilts' towards explaining how the assemblage of a Japanese robot culture has helped in establishing and stabilising robotics as a particular field of technology. A second example would be Bischof (2017, 2015), who also analyses the emergence and practice of social robotics within its wider epistemic and political context. His nevertheless instructive analysis of care in this context is however tilted towards robotics' specific 'access' to that field thus again covering mostly one side of this interconnection. Finally third, Neven (2011) situates his analyses of elderly user representations in innovation processes within broader policy narratives about the desirability and legitimacy of elderly people living at home (Neven 2015). While he investigates the interconnection of robotics and care in development as well as in (prototypical) care practice, his focus is restricted to user representations in (robot) designs, which only represents one component of interconnecting as I understand it. Up until now, the scope of research undertaken in this vein seems to be not entirely adequate in order to address the phenomenon of RobotCare as the present study envisions it. I argue that this is because robotics and care, even though STS scholarship has foregrounded the socio-technical interconnectedness *within* both domains, still treats them as different topics. The following book will provide empirical evidence for closing that gap.

This, however, is not only a question of empirical scope but also of theoretical orientation. Here, the present study does not presuppose the interconnectedness of both domains but rather attends to the (social, technical, political) processes that have rendered robotics and elderly care interconnectable in the first place. The following study investigates these procedural conditions within a specific context, that is, European innovation politics. On the one hand, this means that those conditions will probably be different from, for example, those in Japan or the United States (Šabanović 2007). On the other hand, picking this as the central series allows for centring

[20] Bose und Treusch (2013) follow such a comparative research interest, which albeit inspiring is not what lies at the heart of this study. This is not to say that comparison cannot be part of the investigation. For example, in chapter 4.3 I juxtapose different accounts of 'assistance' in discourses on Independent Living and assistive robotics. However, I do this not for the sake of comparison but rather for studying how, in which concrete material and discursive practices, robotics and care are becoming components of RobotCare.

the interconnection of both elements and not ‘tilt’ towards either of the two. It pays attention to the specifically *political* modality of RobotCare as the primary ‘realm’, where this phenomenon has beomce ‘real’ at all. Looking at these modalities as depending on an ongoing process means to view the resulting interconnections not as natural occurrences but as the products of a long series of efforts that have contributed to rendering robotics and care interconnectable. RobotCare thus is but a temporary accomplishment, which owes itself to contingent but determinate material-discursive conditions.

Here, Suchman (2007) acts as a model for such an analysis, as she attends to the manifold and more or less explicit ways in which humans and machines are reconfigured *vis-à-vis* one another. Especially her theoretical trope of configuration (Suchman 2012) allows to incorporate heterogeneous (material and discursive) layers of analysing human-machine reconfigurations[21]. In practice, these take the form of matchmaking activities by both developers and users. Fitting the affordances of technology and human practice affords fitting them in a mutually engaging process. This point is rendered available by Pol’s notion of ‘fitting’, which at its core is a

> ”relational activity, a way of interacting rather than an effect of machines. Users and devices have to continuously establish what may fit where.” (Pols 2012, p. 39).

While Pols has developed this notion through her study of telecare, I argue that this can be used as a valuable resource to investigate RobotCare on different levels and in different arenas. I take the notion of ‘fitting’ not as restricted to questions of ‘good care’ or ‘care practice’ but rather as a door opener to think of interconnecting as additional work that needs to be invested and actualised to make things and people ‘fit’ – materially and discursively. Finally, taking these two resources together allows for thinking of fitting activities as deeply reconfiguring the entities that are (actively or passively) part of it. Fitting care with robots and robotics with care will leave neither untouched.

The objective of this book is to explore and investigate the processes and practices, which seek to interconnect that which some view as utterly disconnected and others see as already interconnected. Put differently, such an investigation does not presuppose a “cyborg ontology” (Lapum et al. 2012) nor does it employ an essentialist vocabulary of ‘human’ vs. ‘machine’. I rather focus on the pervasive and diverse efforts invested into *rendering robotics and care interconnectable* in the first place.

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[21] However, this also means to abstain from some of Suchman’s humanist testimonies. In regard to this question the present study chooses to follow the post-humanist approach of Barad (2003) in order to allow for a more open analytical framework.

2.4. The challenge of interconnectability

Solutionist and humanist narratives are particularly dominant in framing robots in care either as promising technological fixes to the challenges of demographic change or as unethical colonisation of human aspects of care work. While both positions seem irreconcilable with regard to the question whether or not social robots are able to care for the elderly, they both assume robotics and elderly care, technology and society as separate realms. On the one hand, the solutionist position seems to suggest to simply export robots as autonomous entities into care thus yielding higher efficiency and better quality of care. Consequently, to develop robots is seen as a purely technical task, while society is left with mobilising acceptance *vis-à-vis* robots. On other hand, the humanist position holds that elderly care denotes a purely human activity, which cannot be done by robotic machines due to their lack of empathy and emotion. Consequently, robots can if at all help in instrumental aspects of elderly care, such as, lifting people or logistics.

As a response, research inspired by and situated within STS has challenged such ideas of an ontological separation of technology and society as well as robotics and care. This body of academic work has uncovered the ambivalent role of robots in care as well as of care in robotics. On the one hand, research on robots in care has argued that robots only denote a recent development in an ongoing process of technologisation of care work. Hence, elderly care has always featured instrumental aspects to a certain extent. This strand of research argues that robotic devices in particular are able to mediate care relations under certain conditions. However, while robots certainly yield effects in care they do not do so in an unmediated way. Instead, robots in use are embedded into care arrangements and user practices. As a result, robots in care can often have unpredictable effects such as creating more (care) work or new fields of professional activity. On the other hand, research on care in robotics has argued that the endeavour to build social machines rests on historically contingent and situated ideas about personhood. The introduction of particular ideas about the social or personhood are enabled by an epistemic shift in how robots are developed. This also crystallises in epistemic practice, where roboticists need to reduce and gradually re-introduce social complexities in the design process. So, social robotics has the potential to unsettle certain assumptions about the categories of the human but it also bares the risk of retrenching such distinctions.

STS research is a valuable source for both empirical insights and conceptual inspiration. However, the endeavour of this book also diverts from the framing of STS research on robotics and care. Here, the main objective is not only to tease out the interconnectedness of the social and the technological in elderly care and robotics but also to investigate the manifold ways through which robotics and elderly care have become interconnectable in the first place. Most importantly, such a perspective does not view robotics and care as either separate nor as already interconnected. Rather, it strives to understand through what processes and under what conditions the phenomenon of RobotCare has been produced. For this endeavour, STS holds some invaluable conceptual resources, especially the idea of mutual reconfiguration in human-machine relations as well as activities of fitting as analytical focal point. However, in order to capture the societal breadth of the phenomenon concerned here it is important to further extend the empirical scope as well as re-orient the conceptual framework towards the challenge of interconnectability.

3. The European apparatus of innovation: towards an analytics of interfacing

The present study's conceptual framework follows Foucault's concept of the apparatus. This enables me to capture the wide range of material *and* discursive practices, which have established robotics, elderly care and the concern of an ageing society on the arena of European innovation politics. Here, the following chapter argues that the emergence of RobotCare owes itself to an apparative shift. Put differently, the material and discursive practices enabling this phenomenon are not primarily organised within an apparatus of security seeking to regulate and manage an ageing population but rather within an *apparatus of innovation* aiming to redesign and transform societies according to the imperatives of active ageing and technological innovation. This articulates a shift in discursive register from an "alarmist demography" (Katz 1992) to an opportunist economy, where demographic change and the elderly population are not primarily seen as a threat to society but rather as an opportunity for technological innovation and economic growth (3.1.). This political technology, the apparatus of innovation, attaches unprecedented urgency to the task of interconnecting information and communication technologies, such as robots, with the 'grand challenge' to care for an increasing population of elderly people. The emphasis on 'interconnecting' poses the analytical challenge to grasp the *modes* and *conditions*, through which robotics and care become interconnectable.

The present chapter will answer to this challenge by developing an *analytics of interfacing* (3.2.). Such an analytics departs from the recent interest in the user interface by both the technical sciences as well as by scholars investigating the impact of digital technologies on everyday life. Here, the interface is identified as the primary site, where people and emerging technologies interconnect. However, both of these perspectives exhibit restrictions *vis-à-vis* the above posed analytical challenge of interconnectability (3.2.1.). Capturing the performativity and ubiquity of interfacing RobotCare requires to expand and reconfigure the notion of the interface into two directions: as *practices* and *milieus* of interfacing (3.2.2.). By way of switching between these two conceptual components an analytics of interfacing offers a comprehensive way to understand contemporary politics within an apparatus of innovation (3.2.3.). Furthermore, analysing the interfacing of RobotCare on the apparative level has methodical implications for the research design of this study. Here, I draw on Law's concept of method assemblage. His approach allows me to configure the choice of particular methods not in terms of simply representing RobotCare 'out there' but rather to detect *and* amplify particular aspects of an apparatus of innovation in operation. In this spirit, I outline the research design of three case studies comprised in this book as well as their respective relations to one another (3.3.). Finally, I will conclude the results of my theorising efforts and transition towards the investigation of those case studies (3.4.).

3.1. The European apparatus of innovation

The notion of the apparatus[22] is central to Foucault's analytics of power. It allows him to capture the conditions, under which certain phenomena could gain political reality. Conversely, I will use this concept as an entry point into the analysis of how RobotCare could emerge in the context of European innovation politics. To be more precise the following section will (albeit sketchily) elaborate on the historical conditions that have enabled European innovation politics to talk about and act towards interconnecting robotics and elderly care. Here, I argue that one can observe a shift in how technology and an ageing population are interconnected with one another and their interconnection becomes a political problem, from an *apparatus of security* towards an *apparatus of innovation*. For Foucault, the notion of the apparatus is

> "…essentially of a strategic nature, which means assuming that it is a matter of a certain manipulation of relations of forces, either developing them in a particular direction, blocking them, stabilising them, utilising them, etc. The apparatus is thus always inscribed in a play of power, but it is also always linked to certain coordinates of knowledge which issue from it but, to an equal degree, condition it. This is what the apparatus consists in: strategies of relations of forces supporting, and supported by, types of knowledge." (Foucault 1980, p. 196)

With the notion of the apparatus Foucault attends to the wide range of material and discursive phenomena and processes, power relations and 'types of knowledge', which support and underlie particular forms of politics. It enables the analyst to investigate certain discourses and material configurations as interlocked with regard to a particular set of political strategies. For example, innovation politics in the case of RobotCare is not only about policymakers heralding the advent of assistive machines in elderly care but it also relates to the work by roboticists in developing such machines and to the kinds of interactions (elderly) users are asked to assume with such machines. While this heterogeneity and ubiquity of phenomena is central to Foucault's analysis of power, the concept of the apparatus also allows to observe these in correspondence to a "*uniformity*" (*Foucault*, 1998, S. 84) – that is, a particular mode or set of conditions that gear politics in a certain direction. Hence, the apparatus exhibits both

[22] Since the original French term 'dispositif' is almost impossible to adequately translate into, see English Dreyfus and Rabinow 1983, pp. 119–121, I will stick to the term apparatus, which is the most common translation in the Anglophone reception and translation of Foucault's work. This decision is also to ensure consistency with Barad's discussion of the apparatus, see Barad 2007, which will be introduced later (see section 3.2.3.).

heterogeneity and uniformity with regard to conditioning particular relations, in our case, between robotics and care.

Following this concept of the apparatus, I argue that the urgency attached to interconnecting ageing and technology in the case of RobotCare owes itself to a new kind of political technology, an *apparatus of innovation,* which differs considerably from, what Foucault has termed, an *apparatus of security*. When comparing the way an 'ageing' population features in contemporary political discourse *vis-à-vis* historical accounts throughout Western, modern history, there is a big difference in the rationality and tone. Hence, it is worthwhile to step back a little and sketch how the 'problem of the (ageing) population' has evolved herein.

3.1.1. Bio-politics and the apparatus of security

According to Foucault, the population properly emerged as a governmental concern as a 'natural' phenomenon. In the eighteenth century, economists regarded the population for the first time as an entity, which evades the immediate grasp of the sovereign. The population was not conceived of anymore as a "collection of subjects of right" (Foucault 2007, p. 75) susceptible to the juridical-political power of the sovereign but as an entity governed by laws of nature. This afforded a completely different way of governing

> "…in that the naturalness identified in the fact of population is constantly accessible to agents and techniques of transformation, on condition that these agents and techniques are at once enlightened, reflected, analytical, calculated, and calculating." (Foucault 2007, p. 71)

The population appears as a "datum that depends on a series of variables" (Foucault 2007, p. 71) hence exceeding the relation of obedience between the sovereign and the population. A population cannot simply be ordered to be healthier or more fertile. Instead, it affords rationalised scientific methods and procedures to understand and regulate it according to its 'natural' logic, "the biological or biosociological processes characteristic of human masses" (Foucault 2003a, p. 250). One way in which this naturalness appears is the regularity of demographic phenomena recorded in mortality tables, i.e. the observation that people in a given location die in a regular fashion out of regularly distributed causes. Therefore, the reinterpretation of the population as a natural phenomenon also gave rise to and constituted an effect of new scientific methods and technologies, e.g. statistical estimates and demographic forecasts.

Furthermore, according to Foucault the emergence of the population as a political and scientific problem marks a new configuration of the political: the "birth of biopolitics" (Foucault 2008).

> "It is these processes – the birth rate, the mortality rate, longevity, and so on – together with a whole series of related economic and political problems … which, in the second half of the eighteenth century, become biopolitics' first objects of knowledge and the targets it seeks to control." (Foucault 2003a, p. 243)

Biopolitics denotes the entrance of 'life' into the political realm or, conversely, "power's hold over life" (Foucault 2003a, p. 239). Biopolitics, or biopower, is in stark contrast to the previous right of the sovereign to kill and let live. Instead biopower manifests "the right to make live and to let die" (Foucault 2003a, p. 241). With regard to the population, this means that it became target of medical and administrative modes of knowing, ordering, and governing. People were conceived of as being healthy or unhealthy, normal or abnormal with regard to the constitution of the whole population (Katz 1992, p. 208; Foucault 2003b). The decision who is worthy enough to live and who should be left to die essentially becomes an administrative task informed by medical expertise but also other disciplines, such as statistics or biology.

Within this regime, phenomena of pathology, perversion or abnormality were not treated as a problem confined to the individual undisciplined body but as affecting the population as a whole (Foucault 2003a, pp. 251–252). According to Foucault this manifested in a new kind of technology of government through which such problems could be addressed on the level of the masses.

> "…a technology which brings together the mass effects characteristic of a population, which tries to control the series of random events that can occur in a living mass, a technology which tries to predict the probability of those events (by modifying it, if necessary), or at least to compensate for their effects. This is a technology which aims to establish a sort of homeostasis, not by training individuals, but by achieving an overall equilibrium that protects the security of the whole from internal dangers. So, … *a technology of security*." (Foucault 2003a, p. 249, my emphasis)

The target value of biopower is the establishment and preservation of a certain biosociological balance. However, such a state of 'homeostasis' is seen as endangered by pathologies internal to the population body. Such 'internal dangers' were not epidemic but endemic. Whereas, for example, the problem of morbidity has already figured as a problem since the Middle Ages that problematisation used to be restricted to epidemics, i.e. *temporary* disasters killing vast numbers of people such as plagues or environmental catastrophies. By contrast, the regulatory regime of biopolitics is concerned with morbidity as a *constant* threat lurking *within* the population. Endemics refers to "the form, nature, extension, duration, and intensity of the illnesses prevalent in a population" (Foucault 2003a, p. 243). It is in this sense that 'society must be defended' against internal perturbation. Thus, the measurement, differentiation and regulation of populations became the central concern of biopower and the primary vehicle for its proliferation. It was framed as a problem of security leading to technologies aimed at sustaining the population in a stable homeostatic state.

3.1.2. Alarmist demography

In this context 'old age' was gradually singled out as a phenomenon in its own right. It became a problem especially within the context of industrialisation as elderly people were deemed unfit for manual labour and thus fell "out of the field of capacity, of activity" (Foucault 2003a, p. 244). Following Foucault, cultural gerontologist Stephen Katz has linked this rise of biopolitics and the institutional and professional treatment of the elderly as a problem of government with more recent discourses on demography and gerontology (Katz 1996, 1992). In his analysis of literature on demographic change and an ageing society he gives an account of how policy makers, professionals and the media configured an ageing population in the 1980s and onwards. It is described as "a rapidly growing population of needy, relatively affluent persons whose collective dependence is straining the economies of Western industrialized nations" (Katz 1992, p. 203). Through such ageist stereotypes, elderly people are perceived as a threat to the national economic order and the welfare state, especially with regard to the health care system where the consequences are expected to be most severe. According to Katz's analysis they are portrayed as a homogeneous and problematic group threatening to strain the 'active' population. This perception of demographic change then leads to ethical debates on how to distribute and whether to ration increasingly scarce resources within the healthcare sector mounting in the question "whether the elderly should die … because of their excessive dependence on 'societal resources'" (Katz 1992, p. 205). The demographic 'crisis' is here understood as sparking an intergenerational conflict on the distribution of scarce resources. One can witness here, at least within the speculative mode of ethical reasoning, the biopolitical verdict of who should live and who should die, where the elderly seem to fall under the latter category[23]. Katz calls such discourses, which marginalise and blame the elderly for threatening the economic viability of capitalist society 'alarmist demography'.

In his view, this discursive formation links back to, on one hand, the professional and institutional enclosure of the elderly within old age homes, and, on the other hand, to Malthusian

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[23] This can be viewed as a case for an "economization of life", similar to what Michelle Murphy describes with regard to family planning and reproductive justice, see Murphy 2017. Here, infrastructures of calculation and experiment distinguish between lives to be born while others are not considered worthy enough to be born. Also, the right to live is granted to some and denied to others out of (national) economic considerations.

anti-populationist discourse reconfiguring population growth as a threat to society. The old age home of the early twentieth century manifested the ‘custodial’ location where the elderly could be rendered a target for biopolitical power. Simultaneously, this enabled the ‘invention’ of the elderly population as characterised by its “poverty, illness and dependence” (Katz 1992, p. 214). Malthusian discourse then again connects (especially but not only) the dependent population and its unchecked growth *per se* to social crisis. Population growth intensifies the fight for scarce societal resources sparking riots and public disorder. For instance, in the United States this gave rise to social darwinism depicting marginalised groups such as the elderly “as sources of social degeneration and economic threat” (Katz 1992, p. 216). These two discursive threads converged into a particular technology of demographic knowledge: the social survey. Here, the plotting, enumeration and categorisation of demographic data was interconnected with the anti-populationist register of Malthusian discourse (Katz 1992, p. 216). The social survey denotes “an instrument that correlates the normalcy of the elderly as a special population with their dependency, unproductivity, poverty, superannuation, institutionalization and debilitation (sic)” (Katz 1992, p. 218). It is with the social survey that these characteristics were established as the natural state of old age materialising its relationships with society within an alarmist register.

3.1.3. Active and healthy ageing

In more recent time the way an elderly population and its growth is configured as a problem of government changes register[24]. With it, demographic change is viewed as an opportunity rather than a threat for society. An apt starting point for deciphering this shift is the re-interpretation of ageing as ‘active ageing’ by the World Health Organisation:

> “Population ageing is one of humanity’s greatest triumphs. It is also one of our greatest challenges. As we enter the 21st century, global ageing will put increased economic and social demands on all countries. At the same time, older people are a precious, often ignored resource that makes an important contribution to the fabric of our societies.” (World Health Organization 2002, p. 6)

‘Ageing’ is presented here as a global phenomenon pertaining to the whole of ‘humanity’ affecting ‘all countries’. In the account of the WHO, population ageing is celebrated here as

[24] This change in register does not signify a clear-cut break with the previously dominant alarmist regime. Rather, the term ‘register’ is chosen intentionally here. Just like registers on an organ, contemporary discourse on ageing and technology comprises different ‘tonalities’, which overlap and support one another. Therefore, in the following I will argue that an opportunist register becomes central to an apparatus of innovation, while this, in part, still owes itself to other – namely alarmist – undertones.

‘humanity’s greatest triumph’ and that the elderly are portrayed as ‘a precious resource’ for society. This stands in stark contrast to the representation of the elderly within the ‘alarmist’ discourse. Ageing is not foregrounded in Malthusian terms as an accelerator for an ever fiercer competition for scarce resources but as a resource in itself. One could interpret this as a re-articulation of ‘populationist’ discourse with its proclamation of population growth as a sign and source of productivity. However, this would miss the tendency of the ‘active ageing’ discourse to also view ageing as a societal ‘challenge’. Potentially, the “demographic revolution” (World Health Organization 2002, p. 6) will have negative effects, if governments do not respond to it. The diagnosis of ageing as a global challenge is tightly connected to an invocation to act: “The time to plan and to act is now” (World Health Organization 2002, p. 6).

I read this as a change in register. Instead of mobilising a dystopian vision of how demographic change will lead to the downfall of society, the WHO’s register at least adds another view on ageing: The elderly do not necessarily constitute a threat to society but could be viewed as an opportunity, as an underestimated resource. This diagnosis diverts from respectively adds to contemporary studies of the bio-politics of active ageing. For example, such analyses read active ageing as a marker for how the challenge of ageing has become globalised (Neilson 2003). They also recognise its entanglement within neo-liberal politics, which emphasises the individual’s ability to care for herself while at the same using this as an opportunity to loosen the custodial net of the welfare state (Neilson 2006). Elsewhere, active ageing is seen as investing the ageing body in a new way within consumer culture and techniques for self-optimisation (Schroeter 2008). While these analyses have their points and certainly capture part of the phenomenon at hand I am interested in a different effect of this turn to active ageing, namely that ageing is configured as playing field for technological innovation.

3.1.4. An opportunist economy and the apparatus of innovation

In March 2015 the first ‘European Summit on Innovation for Active and Healthy Ageing’ took place in Brussels. At this event over a thousand

> “leaders from government, civil society, investment and finance, industry and academia discussed how Europe can transform demographic change into opportunities for economic growth and social development.” (European Commission 2015a, p. 5)

The summit marked an occasion for the “co-creation of the future EU agenda on *innovation for active and healthy ageing*” (European Commission 2015a, p. 6, my emphasis). Technological innovation is positioned here as the main solution to demographic change. Conversely, demographic change is not seen as threatening the prosperity of society but instead as opening up a wide range of *economic opportunities*. For example, the growing population of the elderly is expected to lead to a “Silver Economy” (European Commission 2015a, p. 8, 2015b) where assistive technologies become a major factor in creating both economic growth and jobs. The elderly are not primarily perceived as patients depending on medical attention (European Innovation Partnership on Active and Healthy Ageing 2011a, p. 5) but in economic and technological terms: a ‘silver economy’ configures the elderly as consumers and users giving rise to new markets and the need for user-centred innovation. As such, demographic change is not primarily conceived as a looming threat to society but as opportunities yielding economic benefits to society (e.g. new consumer markets, new jobs). Hence, the most important reference point of the summit described above is not an alarmist demography but an *opportunist economy*.

In this context, technological innovation is put at the centre of attention as “our best means of successfully tackling major societal challenges” (European Commission 2010b, p. 2). It is primarily information and communication technologies, which feature as promissory means to seize this new space of opportunities opened up by an ageing society. Here, the application of robotics to elderly care plays an important role as a key solution to increasing numbers of recipients of care and decreasing numbers of care personnel. On occasions like the ‘European Summit on Innovation for Active and Healthy Ageing’ robots are often staged as the most visible ambassadors of the future of care (see figure 1 & 2). Such robots promise to raise (cost) efficiency, lower frequencies of hospitalisation and prevent social isolation in the long-term care of, for example elderly people with dementia. By assisting caregivers and the elderly in

Figure 1 Roboticist presents Kompaï, a companion robot, to a summit visitor (European Commission 2015a, p. 50)

Figure 2 Roboticist presents the Robot-Era prototype to a summit visitor (EC 2015c: 51)

their everyday tasks robots are expected to both lower the burdens of care work and to enable the elderly to live more independently. Human assistance must then only be available ‘at the point of need’.

This positioning of *technological* innovation as primary vehicle of contemporary politics has its own history, in which innovation has been transformed into something inherently positive and almost exclusively related to material technology (Godin 2015). This has not always been the case. For example, up until the 16^{th} and 17^{th} century innovation was used as a negative concept – with regard to the established religious order at the time. It was used as a synonym for and, in the process, replaced the concept of 'heresy' (ibid., pp. 97f.). Furthermore, the evolution of the term was by no means restricted to either the domain of religion nor was it originally tied to either the market or material technology (for example, it was used as a proxy for political, that is, republican revolution). This restriction was only the product of a long series of transformations and journeys of the term through different domains of social life. It is only in the course of the twentieth century that the concept attained its exclusive meaning as technological innovation through its uptake within the field of innovation studies (ibid., pp. 261ff). In this context, innovation becomes synonymous with "the commercialization and use of technological inventions" (ibid., p. 278). On top, technological innovation has travelled back into the political realm configuring the translation of scientific knowledge into 'useful' and 'marketable' products as the panacea to almost any social problem (Pfotenhauer and Jasanoff 2017; Kaldewey 2013). It is this reconfigured and historically specific notion of *technological* innovation that appears as the 'natural' companion of ageing as a political problem.

Hence, an opportunist economy does not only rely on a re-valuation of ageing but also of innovation respectively technology. Taken together, government is not primarily seen in terms of a regulatory challenge, in the sense that the population must be defended against (endemic) perturbations and be kept at a desirable equilibrium, but rather as a challenge to *innovate an ageing society*, i.e. to redesign elderly care through interconnecting it with robotic technology. It ultimately "takes technical change to be the model for political intervention" (Barry 2001, p. 2). Hence, I argue that the treatment of demographic change within European innovation politics is not configured by an "apparatus of security" (Foucault 2007) but rather by, what I term, an *apparatus of innovation*. Here, social problems are coupled not primarily to the natural working of the population or to medical problematisations but to the ability of policy-makers, engineers, and entrepreneurs to innovate society, *to interconnect social problems with technological solutions*.

3.1.5. Opportunist registers of innovation and ageing politics

The way an ageing population and demographic change feature as a problem of government has profoundly changed. Within European ageing politics an 'opportunist' register has wheeled past an 'alarmist' discourse diagnosed by Katz (1992). However, this should not conceal the fact that there are still apparent continuities with regard to previous configurations of the population as a problem of government. The strategic efforts of the European Union partly articulate 'alarmist' discourses framing ageing as potentially undesirable. Even though the rhetoric changes from the diagnosis of 'threats' to 'challenges', this still means that if remaining unresolved demographic change is expected to have extremely negative effects on society. Also, the turn to active ageing and its re-appropriation within innovation policy does not mean that the elderlies are finally empowered and liberated from the disciplinary regime of an alarmist demography. Rather, this new uptake of ageing within the register of innovation engenders new power/relations and strategies, which rest on similar assumptions as diagnosed by Katz. For example, programmes of active and healthy ageing do not merely presume the elderly as already active but rather work against a presumed in-activeness both on the part of the individual elderly person but also on the part of societal imaginaries about old age. Put differently: active ageing is not a programme of activity but of activation. Schroeter (2008) shows this with regard to the regime of fitness where the elderly are made to work on their ageing body to stay fit and healthy. Furthermore, the interconnection of elderly care with information and communication technologies like assistive robots brings to the fore new and old stereotypes about the elderly which represent them, for example, as dependent and resistant to technological change (Neven 2011, pp. 167–179). That is why this process does not denote a clear-cut break with previous configurations of ageing and technology as governmental concerns but rather a *switch in register*. The discourse of an opportunist economy *adds* another set of tonalities to the structure of contemporary politics while also reconfiguring previous problematisations.

Hence, the concept of an apparatus of innovation is to be understood as an analytical lens that complements and adds to established research and discussions about the bio-politics of ageing (and technology) rather than simply replacing or devaluing them. The material and discursive practices analysed in the course of this book exhibit characteristics, which cannot be fully answered by using concepts such as bio-politics and its more conventional reception. The discursive register of an opportunist economy makes the backdrop for a different way of doing politics. While the alarmist register of bio-politics treated an ageing population in negative terms (as something that society must be defended from), the opportunist register frames ageing in 'positive' or (economically) 'productive' terms. Central to this kind of politics is the production of ever more ubiquitous and intimate interconnections between robotics and elderly care, between old people and digital devices, between the state and business, industry and academia, between assistive technology and an ageing society. It is under these conditions that robotics and care can even begin to become interconnectable. The central preoccupation of this kind of politics seems to be to create circumstances and set processes into motion, which enable formerly disparate domains, topics and elements to interconnect. It is this new urgency attached to the very task of interconnecting the social and the technological, which I see as the most central feature of an apparatus of innovation and its operation.

3.2. Towards an analytics of interfacing

How to deal with this phenomenon both in theoretical and analytical terms? The chapter at hand is built on the assumption that the above delineated research focus requires a shift in perspective as well as in terminology. It does not suffice anymore to simply attend to the interconnections between robotics and care as such but rather it affords a displacement towards the conditions and modes that bring about and stabilise a particular order of interconnectability in the first place. That is why the following section will take as its starting point the notion of the 'interface'. User interfaces in their various forms attract the attention by social theorists. User interfaces of various forms proliferate within and become pivotal features of an increasingly technologising society. As a result, the interface is put forward as a trope by theorists of technology and media as a way to grasp the materiality of digital technology and culture. However, this two-fold interest has its limitations namely in the rigidity and technology-centredness of 'the' interface. By contrast, the following section endeavours to proceduralise and decentre the interfaces towards an analytics of *interfacing*. Such an analytical position will allow me to attend to the dynamic and ubiquitous ways, through which robotics and care have gradually been rendered available for one another.

3.2.1. The human-machine interface as object and analytical trope

In the advent of novel, interactive technologies, user interfaces are becoming more and more the centre of attention – by engineers and social theorists alike. This can be witnessed in the case of robotics, too. Here, the conditions for robots to have an impact on and to be accepted by society is seen as hinging on the *human-machine interface*:

> "Robots will increasingly interact with people. This interaction will be essential to the acceptance and integration of robots into our everyday lives. It might be through buttons and a screen, or through physical interaction and gestures. Interaction will move *from computer like (sic) interfaces to ones based on intuitive interpretation of a user's intentions*" (Partnership for Robotics in Europe 2013, p. 76)

The user interface is identified as *the* major factor in enabling the interaction not only with human users, e.g. elderly people or caregivers, but also with 'our everyday lives' in general. As robots are expected to turn into interactive machines, this project is equated to a large extent with the evolution of user interfaces. While now "[t]ouch screen interaction is commonplace" (ibid.) the research agenda promises "interfaces that can assess the emotional and cognitive state of the user" (ibid.) by 2020. Thus, it is the touch screens, buttons, and sensors, as well as their supposed 'intuitiveness' through which robots and people are interconnected – and even more so – through which the interconnecting of robotics and 'our everyday lives' becomes possible in the first place. The human-machine interface is understood as an object, as a computational component that requires the diligent work of engineers and computer scientists in order to be operative. Thus, the above quote connects to the technologically determinist narrative in social robotics that views the interaction of robots and people as constituting a solely technical problem[25] (Šabanović 2010b). However, user interfaces always exhibit and require mutuality between technology and its users. In the context of robot development, this is witnessed by concepts such as "usability" or "user-centred design" entering robotics and Human-Robot Interaction as desirable design values (Mast et al. 2015). Here, it is deemed crucial for user interface design to incorporate human *and* technical factors.

In social and media theory interfaces have been described as vehicles for "the deployment of computational power into all aspects of human life" (Hookway 2014, p. 148). This centrality of interfaces in contemporary societies has motivated a number of studies. For instance, scholars in media studies have pointed to the fact that human-machine interfaces offer new and enhanced ways for users to interact with technology while at the same time restricting or invisibilising these possibilities (Galloway 2012, p. 69). Interfaces materialise particular design assumptions about users, which are imbued with racial, gendered, and class stereotypes (Marino 2006). Consequently, analyses of the interface have strived to expand the meaning of the interface as effect (Galloway 2012) or relation (Hookway 2014, ix). For them, the interface is more than an object, it is central to the contemporary production and government of people's relation with technology.

[25] In this context, also the notion of 'interfacing' is used. However, this is too understood as a technical task of constructing and programming user interfaces of different sorts, see Bogue 2013.

> "Today the interface is at once ubiquitous and hidden to view. It is both the bottleneck through which all human relations to and through technology must pass, and a productive moment of encounter embedded and obscured with the use of technology. (…) While the interface operates in space and time … it also governs the production of sites and events; it describes the site or moment in which the full operation and apparatus of systems, networks, hierarchies, and material flows are distilled into concrete action." (Hookway 2014, ix)

The interface signifies the central site where socio-technical interconnection operates. It seems to be the (metaphorical[26]) means *par excellence* to imagine and represent the ever increasing interconnectedness of people and machines within contemporary society. To put it more radically, the interface *produces* and *governs* the relations through which humans and technical objects can or cannot interconnect. This renders available an important point: User interfaces are not simply a means to render technology more interactive. At the same time they are means for government and control. In the case of RobotCare, natural and distributed interfaces, such as, fall detection sensors, speech recognition, touch screens, will enable to monitor and surveil elderly people at home (López 2010; Paterson 2010; Neven 2015). This shows how political agendas and visions are translated into technological objects. It makes visible the political qualities of interfaces (Winner 1980).

However, while such an analytical expansion of the notion of the interface renders available important points for the analysis of interconnecting robotics and care, it still remains attached to the interface as a technical object. While it appears to be suitable for analysing how particular political agendas materialise in user interfaces it excludes those political agendas themselves from the analysis. By this, I mean that restricting the notion of the interface to the material and computational entities that digital technology and culture have produced, gives away the chance of using the full potential of this notion to analyse politics itself in terms of the interface. It also literally fixes the notion of the interface to a more or less static 'thing', i.e. the sensor, the touch screen et cetera. That is why I argue that there is analytical potential in further expanding the notion of the interface and especially re-conceptualise the interface in terms of its performativity. For this, I argue, we need to switch from thinking about the interface to thinking in terms of *interfacing*.

[26] There are numerous examples not least in STS itself, where the term 'interface' is used in a metaphorical sense to describe activities or phenomena at the intersection of different spheres or domains.

3.2.2. From the interface to interfacing

Hence, the following section will move away from this static and technology-centred notion of the interface towards a performative and distributed account of *interfacing*. This will be done via two critical movements: re-directing the analytical attention towards *practices of interfacing* (3.2.2.1.) and *milieus of interfacing* (3.2.2.2.).

3.2.2.1. Practices of interfacing

The idea of the human-machine interface as a technical object implies these elements as pre-existent and the interface as that which stabilises the interaction between them. Taking into account how human-robot interaction operates in practice, this denotes a misleading assumption. Instead, deploying interfaces means to meticulously and laboriously adapt and reconfigure the elements meant to be interconnected. Hence, a more adequate lens to look at the performance of interfaces is to focus on *practices of interfacing*, that is, on activities oriented towards making those elements interconnect. This move is enabled by Karen Barad's concept of intra-action and Gilbert Simondon's principle of montage.

In order to show the shortcomings of the concept of 'the interface', I shortly take a detour via some preliminary findings from the analysis of human-robot interaction in a European robotics R&D project (see chapter 5). Here, roboticists aimed to demonstrate the interactivity of socially assistive robots for an ageing society through laboratory experiments with (elderly) users. Users and robots should mainly interact via a speech interface that comprised a microphone held by the user, a laptop connected to the robot system, and a speech recognition software running on that laptop. In the course of the tests, the speech interface did not stabilise the interaction between robot and user nor did it leave them untouched. Rather, the following field note shows that it produced all kinds of issues, mishaps, and breakdowns, which resulted in roboticists' efforts to constantly reconfigure both human and machine.

Getting 'speech' right

Field note (10/06/15)

The experiments are about to begin, when a problem with the speech interface comes up. The robot system does not seem to react properly to the commands of the user. One of the roboticists addresses the test person: „Could you avoid holding the microphone too close?" He prompts her to fasten the microphone to her pullover's collar. That way the distance between the test person's mouth and the microphone would remain constant. After a few more attempts to initiate the sequence, another roboticist comes from another room in the test apartment, the 'control room', and asks the test person to speak slower into the microphone. The problem persisted. This was strange since the speech interface had just worked when the user had tested it in the control room.

After the tests, the roboticists explain to me that the microphone was simply connected to the wrong laptop. The reason why it worked earlier was that the laptop with the speech software on it stood next to it and recorded the voice via its own built-in microphone.

In this vignette, we see that, on one hand, the scope of elements that are involved in the deployment of human-robot interfaces are greater than simply ‘the human’ and ‘the robot’. It involves roboticists’ instructions, interferences of sound, falsely connected components, the user’s vocal cord or the user’s collar. On other hand, those elements are not fixed but rather need to be continuously adapted and reconfigured *vis-à-vis* one another. Hence, analysing the performance of interfaces is more adequately described by the practices of interfacing that mutually adjust this excess of elements in a continuous regress.

A first resource for doing this is Karen Barad’s concept of intra-action. With this she criticises and diverts from interactionist approaches by offering a materialist constructivism she terms *Agential Realism*. This approach is based on a theoretical discussion of quantum physics as well as Feminist poststructuralist thinking (Barad 1998, 2007). Barad argues that interactionist thinking presumes independent entities, which then enter into an interactive relation. By contrast, she asserts that “relata do not pre-exist relations” (Barad 2003, p. 815) but that they are enacted by entering into relation with other elements. This means that the entry point for analysis and description is not each element by itself but rather the relations within which they come into being in the first place.

This has important consequences for the development of the notion of interfacing. Barad takes the world as in constant motion and, thus, emphasises performativity over stability. Such a view runs counter to a persistent view in STS that non-human elements such as technologies or material objects denote foremost a stabilising force rendering particular social or symbolic relations more durable (Latour 1991). Barad’s Agential Realism seeks to divert from stiffening the analysis of material objects towards stability and – instead or at least complementarily – contrast this view with an emphasis on the open-ended and post-humanist performativity of materiality (Barad 2003). Here, the concept of intra-action plays a particularly important role in that it stresses the potentiality and unexpected agencies of materialisations. Theorising the interface in such a way means to acknowledge the open-ended regress of such practices.

> „Indeed, intra-actions iteratively reconfigure what is possible and what is impossible – possibilities do not sit still. (…) Possibilities aren't narrowed in their realization; new possibilities open up as others that might have been possible are now excluded: possibilities are reconfigured and reconfiguring.“ (Barad 2007, p. 234)

In this sense, practices of interfacing are not finite or simply targeted at a final stage of stability but rather they are more aptly understood as continuous reconfigurings of the world. What seems to confront the observer as 'the world' is not so much self-contained but merely a snap-shot of the continuing game of potentiality and actuality. In regard to my analytical project, this implies that possibilities of interfacing never sit still. They exert an ever-present operational openness. The question of how and which entities will inter- or disconnect, essentially is never fully determined. Rather, the analysis can only observe certain continuities in between one event and the next. For Barad, materiality and technology is not what ties the world together, it is what *keeps the world in motion*. It supplies the world with noise and unforeseen variability. Along those lines, I do not think about interfacings as the primordial source of stability *vis-á-vis* a particular interconnection but rather as a practice "in its intra-active becoming – not a thing, but a doing, a congealing of agency" (Barad 2003, p. 822). This means that practices of interfacing are not what hold the techno-scientific world together. Rather their ubiquity offers, obliges, and maybe even forces actors to keep interfacing.

Hence technically, Barad does not seek to attend to relations (interfaces) themselves but rather practices of relating (interfacing). The question at the heart of *Agential Realism* is not that of who or what interacts with what or whom but rather how do particular components arise within a complex intra-active space of interdependency. Observing practices of bringing-into-relation takes as starting point not the *a priori* existence of a difference but rather the modality of its operation in terms of an "agential *cut*" (Barad 2003, p. 815, my emphasis) that is effected by any element of a given situation (including the analyst herself). The question therefore is how particular elements *become* separated and interconnected within a particular situation. For example, in the example above roboticists foreground the way the user speaks and point to her pace or loudness that needs to be adjusted. Then, the microphone does not seem to sit right and needs to be fastened to the user's collar. This is not to say that one of those separations or interconnections is strictly more important than others. First and foremost, it matters that they all are involved in and produced by continuous efforts to interface.

Albeit, Barad's *Agential Realism* inspires a critical analytics of interfacing, such an approach also fails to deliver a heuristic repertoire for approaching practices of interfacing empirically. It misses a more fine-grained vocabulary which could describe how exactly the intra-active production and reconfiguration of interconnectable entities comes about. For example, what does a performativity of interfaces mean for analysing the concrete practices in a robotics laboratory? In order to remedy this shortcoming I will now draw on Gilbert Simondon's philosophy of open objects and, more precisely, on his notion of montage to outline the theoretical resources it offers for an analytics of interfacing. With him, those practices become conceivable as particular sets of activities oriented towards rendering formerly disparate elements available for one another.

Within the context of his philosophy, Gilbert Simondon focuses on technical objects via the principle of montage, that is, their embeddedness in particular setups (Simondon 2017). For him, technical objects are never isolated but always taking part in wider networks of elements. Hence, to construct something relies on a continuous practice of rendering those different elements available for one another.

> "Having become detachable, the technical object can be grouped with other technical objects according to such or such setup [*montage*]: the technical world offers an indefinite availability of groupings and connections. For what takes place is a liberation of the human reality that is crystallized in the technical object; to construct a technical object is to prepare an availability." (Simondon 2017, p. 251)

With the principle of montage Simondon argues against the Aristotelian hylemorphism, which asserts the distinction between the creative subject (the craftsman) and passive matter (Simondon 2017, pp. 248–250). Instead of relegating the technical object to the stuff that lends itself to human ingenuity, he argues for a detachability of the technical world, which exhibits a logic of its own and thus requires particular attention. This detachability forms the pre-condition for montage. Objects need to become detachable, that is, available for their recombination in the context of particular technical setups [*montages*]. Hence, to construct a technical object means to install interconnections between them, that is, "to prepare an availability" (Simondon 2017, p. 251) of elements to be interconnected. It is this 'universal' detachability of elements, their separating from other elements, as well as their availability for recombination, their interconnecting with other elements, that characterises the technical operation (Simondon 2009). For Simondon, objects are thus to be considered open, that is, as part of (more or less) standardised networks. What a given object is, what function it may attain is only resolved within such networks. This characteristic of technology is not a-historical but arises especially within networked cyber-physical systems of digital culture. That is why the concept of open objects has lent itself to the analysis of more recent developments, such as open source software or open fabrication (for example, see Schneider 2017). This attention to openness makes the concept a viable entry point into the analysis of social robotics, a highly complex technological field, which affords the montage of a whole array of socio-technical relations. For now, the most important point about this concept is that Simondon views technology not as matter or product, but as a particular mode of existence, an ongoing activity. For an object to attain some kind of stability or functionality, it needs to remain at least potentially available for (re)configurating and (re)adjusting (Simondon 2017, p. 255).

With regard to the theoretical project of an analytics of interfacing, Simondon's philosophy of open objects offers a heuristic repertoire. It helps to construe interfacing as a more or less technical operation, in the sense that it prepares and renders available for one another formerly detached elements *vis-à-vis* the technical object – and vice versa. However, as we have seen in the above example, this denotes a risky and frail endeavour. Interfacing human-robot interaction (all the manifold elements that feature as part of it) is constantly confronted with (temporal) unavailability, that is, with materialities that withdraw or actively resist interconnection. Here, a return to Barad's post-humanist materialism is fruitful since agential cuts and intra-actions are not effected by 'the human observer' but within spaces of intra-active interdependency featuring human *and* non-human elements. Hence, interfacings include and need to deal with the risk of unexpected resistances and withdrawals all the time: "there is a sense in which 'the world kicks back'" (Barad 2007, p. 215).

Such resistances or withdrawals should however not be read as maintaining some kind of residual essence or difference between, for example, humans and machines (Suchman 2007, pp. 268–271). Such analysis does not only restrict the range of critical responses but also the breadth of analytical avenues. In this regard, an analytics of interfacing suggests to, on one hand, abstain from such classifications while, on other hand, pay close attention to how and under which conditions humans and machines become interfaced – both materially and discursively. Indeed, the very assumption that two things can be interconnected denotes an ontological claim, where in the act of interconnecting it assumes a symmetry at the surface of both entities. Even more so, it denotes a particular political rationality that views such interconnectabilities as opportunities for growing the economy or creating jobs (see section 3.1.). In following such practices the analyst of interfacing assumes the role of an engaged but distanced observer, who, on the one hand, is critical of the contingent modes and conditions to which such interconnections owe themselves but, on the other hand keeps out of the ontological ping-pong between what really makes a robot and what really makes a human being[27]. This is of course not to say that the analyst can completely refrain from assumptions (such as where to

[27] The metaphor of ping-pong refers to the endless discursive game, which especially seems to be proliferating in discussions around robots in care which I have outlined in the previous chapter (see section 2.1.). Such debates are comparable to ping-pong in the sense that they can be described as an antagonistic game, in which both parties are not interested in anything else than the game itself, i.e. hitting the ping-pong ball so it hopefully brings the other side into trouble but, at the same time, taking for granted the games' ever same rules.

look for 'human' or 'non-human' surfaces), since she is always part of the apparatus she observes. However, there are degrees of freedoms in empirical observation, which vary according to the hermeticism of such assumptions. In other words, an analytics focusing on the performativity of interfacing does not primarily yield insights into the essential qualities of humans or machines but rather can render visible the modes and conditions through which particular surfaces[28] become available or unavailable for interconnection. We might then distinguish between more or less successful or adequate attempts to interconnect depending on the standpoint we take.

As a first interim conclusion, I have managed to proceduralise the notion of the human-machine interface as a technical object towards an account of practices of interfacing. This was possible with the help of Barad's notion of intra-action and Simondon's principle of montage to transition. Practices of interfacing denote the ensemble of practices, which aim to regulate and safeguard availability. Such practices consist of two intra-active operations which empirically take place simultaneously and which presuppose one another. However, they can be analytically distinguished as moments of 'separating' and 'interconnecting'. Interfacings produce difference, that is, they assume the elements of phenomena to be interconnected as formally different from one another. For example, human-robot interaction as well as social robotics separate robots from the human. They isolate 'the human' and 'the robot' as the primary anchor points where practices of interfacing can latch. At the same time, interfacings operate via a symmetry of interconnection. This means that they mobilise different surfaces (bodies, things, technical objects, people, etc.) as a resource for their respective interconnection. In this sense, on the level of interconnection, interfacings do not make a difference between human and non-human, between social and technical elements. The most important criterion, then, is solely whether an entity proves to be available for interconnection or not.

3.2.2.2. Milieus of interfacing

The common notion of the *human-machine* interface is mostly restricted to micro-logical relations between technology and people. Interfaces either feature as mere manifestations of digital culture (Galloway 2012) or as restricted to certain technical phenomena, such as the cockpit and its relation to the pilot (Hookway 2014). Instead, I will argue that, in order to grasp the material *and* discursive operation of an apparatus of innovation, the analysis must be elevated to further levels beyond mere human-robot interaction. To achieve this, I will first

[28] Without granting an *a priori* precedence to the human face.

show how human-machine relations rely on distributed conditions, thus, gradually decentring the focus towards the wider material and discursive environments, in which practices of interfacing are embedded. Hence, it does not suffice to look at practices alone. Rather, a complementary perspective is needed that looks at the distributed composition of *milieus* of interfacing. This move is enabled by Gilbert Simondon's concept of the *associated milieu* and will be critically developed further with Karen Barad's focus on the mutual entailment of *material* and *discursive* practice. Based on the latter extension of the meaning of the milieu, I will show how the particular relations between robots and people are embedded within wider, discursive milieus of European innovation policy.

Processes of interfacing act on the *associated milieu* (Simondon 2017), or more specifically: they enact the world *as* milieu. For explaining this, I will turn back to the example I used at the outset of the previous section. Here, it shows that in order to make "[r]obots … increasingly interact with people" (Partnership for Robotics in Europe 2013, p. 76) roboticists need to prepare and install the material circumstances of HRI experiments, in this case, a so-called test apartment. The following field note refers to a particular incident, in which the environment, the milieu of the test apartment became particularly relevant for interfacing robots and people.

Recalcitrant carpets

Field note (11/06/15)

During the test runs the robot repeatedly struggles to move over the carpet that lies in its 'home position', in the corridor of the test apartment (see figure 3). At times, it gets stuck and it takes the machine a few accelerations to make its way onto the carpet. Such incidents were called 'friction problems', that is, the frayed surface of the carpet caused the robot's wheels to slip. After such an incident the team decides to remove all the carpets from the apartment (see figure 4). It took two of the roboticists to roll all the carpets and carry them out of the apartment revealing the clean and slick laminate floor.

Figure 3 Corridor of test apartment with carpets removed (image: author, 18/08/15)

Figure 4 Living room of test apartment with carpets removed (image: author, 18/08/15)

This is only one example where the participants of the project engaged into seemingly mundane bodily work in order to accommodate the robot system within the milieu of the test apartment. Here, it is important to note that the seemingly simple task to navigate around in a common living room denotes an extremely difficult task for robots. This is not necessarily due to technical failures alone but rather due to incompatibilities between particular surfaces of the robot and particular surfaces of the environment. Hence, the operation of robots does not simply rely on the particular technical components inside the robot but rather on their intra-action with the robot's surroundings outside of it. With Simondon I think of this as the associated milieu of human-robot interaction.

> "It is that through which the technical object conditions it, just as it is conditioned by it. This milieu is not fabricated [*fabriqué*], or at least not fabricated in its totality; it is a certain regime of natural elements surrounding the technical being, linked to a certain regime of elements that constitute the technical being. The associated milieu mediates the relation between technical, fabricated elements and natural elements, at the heart of which the technical being functions." (Simondon 2017, p. 59)

For Simondon technical objects are inseparably linked to their environment, i.e. their associated milieu. Even more so, if one wants to analyse a particular object ('the technical being') its milieu must be analysed as part of that object. In its concrete operation a technical object is surrounded and pervaded by the milieu, as it renders available the very relations that a particular technical object can enter into and maintain with other elements. In the above example it becomes clear that in order to make the robot system work in the particular milieu of the test apartment myriad precautions and careful considerations need to be directed towards the robot's surroundings. In this case it is the carpets on the floor which "kick back" (Barad 2007) against the robot's wheels and, with it, against the endeavour to design services for an elderly population. Consequently, such 'friction problems' are worked on as recalcitrant surfaces of the milieu acting as a difficult terrain for robots to navigate. It also becomes clear that, as Simondon puts it, the milieu can never be 'fabricated' or controlled entirely[29]. Even in the

[29] The categories of the 'natural' and the 'artificial' are admittedly not the most fitting ones for the present case of a test apartment, where it could be argued that the entire milieu is artificial. However, these former categories are a direct consequence of the kinds of cases from which Simondon develops his notion of the milieu. For example, Simondon repeatedly mentions the example of the Guimbal turbine, see Simondon 2017, pp. 59–62, 2009, p. 19, which could only exist associating natural forces (the circulation of water and oil) and technical objects (the turbine and a generator). In the case of social robots in (prototypical) care environments it is however much less about the difference between 'natural' and 'artificial' but rather between 'socio-material' and 'technological' orders of complexity – and how they clash. This needs to be kept in mind, when applying Simondon's concept of the milieu to such cases. To conclude, I take the notion of the milieu not as restricted to a particular class of technical objects but rather as an argument about technology in general, namely, that associated milieus always exhibit a surplus of

almost technological, tidy space of the test apartment, 'natural' disturbances and interferences can occur. For example, one of the roboticists told me that incoming light often poses a problem for the robot's sensors as they cannot recognise objects anymore[30]. This also shows how the distinction between 'natural' and 'technical' is not an absolute distinction but rather relative to the position within a particular milieu. While for humans, the milieu of the laboratory apartment might seem highly technical and tidy, for a robot system such a milieu is still highly incalculable as unexpected disturbances frequently occur.

So we see that, for Simondon, the notion of the associated milieu is closely tied to the conditions respectively the conditioning of processes of relating. As Barad switched from looking at relations themselves to focusing on processes of relating, the notion of the milieu offers a way of empirically investigating this rather abstract idea. For instance, in the above example, we can see how roboticists continuously act on the milieu in order to install, prepare and, at times, remedy the conditions for particular interconnections to occur (and others to remain absent). Hence, bringing together the notion of interfacing with the notion of the associated milieu offers the following definition: a *milieu of interfacing* denotes a distributed ensemble of un/available entities acting as (difficult or favourable) terrain for processes of interfacing to operate. Such milieus are distributed in the sense that they entail myriad entities in different localities. Thus, interfacings cannot be reckoned back to one subject or one particular object but rather to a whole milieu of diverse (molecular, physical, organic, sensory) surfaces.

Thus, interfacing does not denote solely „human-based practice(s)" (Barad 2003, p. 820). It is something that involves, extracts, and exploits distributed, heterogeneous agencies. Therefore, it has to be noted that processes of interfacing themselves cannot be reckoned back to the agency of someone or something *per se*. Efforts of interconnecting may be heterogeneous control projects with human 'participation'. They may be what Law (2011) has called „heterogeneous engineering". However, this means that this process affords tactics and strategies, which have to acknowledge the never fully controllable potentiality of the milieu. Even though the apparatus of innovation may propagate an almost universal interconnectability of the world, it is especially such projects, which time and time again stumble upon the techno-material entropy

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complexity when it comes to controlling it. However, this hint to the situatedness of the concept also calls for attention to the *particular* elements and operations, which make a *concrete* associated milieu.

[30] Computational visual sensors do not 'see' ready-made objects but rather need to algorithmically infer those objects (e.g. a bottle) from patterns in digital image data. Hence, if lighting changes in a room so do the pixels of that digital image and previously successful algorithms might not detect a particular object anymore or might take something else for it (e.g. a shadow for a bottle).

of milieus of interfacing. Practices of ‘rendering-available’, therefore, signify situational and, with that, not less precarious efforts of re-stabilising a given arrangement of interconnections whose networked complexity always eludes the grasp of a single controller[31].

So far, the discussion of processes and milieus of interfacing was, albeit preliminary, restricted to the rather local, ‘micro-logical’ milieu of the test apartment and the HRI experiments in it. As adumbrated before, an analytics of interfacing and, therefore, the herein conceived notion of the milieu is not exclusively tied to a material space. Instead, the milieu as I want to construe it is a scalable concept. Milieus of interfacing can entail respectively ‘span’ across discourses, markets, architectures etc. For instance, the test apartment is in itself embedded in further material and discursive milieus. In this particular case it is part of a research and innovation network, which aims to bring together roboticists, entrepreneurs, caregivers, and elderly people to co-create “better and more effective solutions (…) to improve the quality of life for the elderly and sick in their own home environment” (Innovation network website[32]). It comprises a whole network of companies, research institutions, a care home and the municipal housing company. Considering this milieu would entail different elements then if we would simply stick to the test apartment as analytical horizon: for example, particular bureaucratic procedures, budgets, contracted responsibilities, divisions of labour, and agreements of cooperation. Additionally, this milieu is part of the wider discursive milieu of European innovation policy. Not only does the European Union feature among the partners of the network but also the aforementioned agenda of enabling the elderly to live longer and more independently at home links directly to the opportunist discourses previously described. This example is to show that in investigating the conditions of RobotCare, of how robots and people, robotics and elderly care become interfaced the analysis needs to jump between different milieus at different levels.

Hence, also the trope of interfacing is not coupled to material technologies in a strict sense, e.g. a screen or a robot platform, or to human actors, e.g. roboticists and elderly users. In studying the interfacing of RobotCare within the European apparatus of innovation I assert what, in Baradian terms, would be a symmetry between discursive and material practices.

> “The relationship between the material and the discursive is one of mutual entailment. Neither is articulated/articulable in the absence of the other; matter and meaning are mutually articulated. Neither discursive practices nor material phenomena are ontologically or epistemologically

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[31] This needs to be argued, in part, against Simondon’s tendency to decentre the creative subject only to replace it with the engineer as the new ‘master subject’ of the milieu, see Hörl 2015, p. 6.

[32] Name and domain of the website are not indicated for the purpose of anonymisation.

> prior. Neither can be explained in terms of the other. Neither has privileged status in determining the other." (Barad 2003, p. 822)

The principle of symmetry as proposed in the upper quote views reality as both material *and* discursive. This has consequences for how the analyst of interfacing handles the relationship between those two analytical dimensions. Take for example the initial observation of this book that while the discursive promises surrounding RobotCare 'fly high', the techno-material results achieved in lab practice do not live up to those expectations at all. Following Barad's dictum of the mutual entailment of material and discursive practice, however, calls to abstain from trying to simply explain the discursive through the material ('Robotics is a hoax!') or the other way around ('Those problems will soon all be solved!'). I do not ascribe 'more' reality to either, the discursive or the material, playing the former off against the latter. Rather in this study, I will explain how this apparatus of innovation works towards interfacing robotics and care within various milieus, both material and discursive, and how, thus, new fronts and alliances, new relations and cracks emerge. This, of course, does not mean that the analyst cannot, at times emphasise one dimension over the other. In the end, it is a question of how one approaches these phenomena empirically.

3.1.1. Analytics as switching: practices and milieus of interfacing

In this section, I have departed from the common understanding of the interface as object and its conceptualisation as relation in STS and media studies. This understanding conceptually restricts the analytical scope to the *human-machine* interface. Additionally, the substantive notion of 'the interface' narrows the analysis down to the stabilising effects of interfaces as material technologies *vis-à-vis* social interaction. Taking up on this discussion of the interface as an analytical trope I have proposed an analytics of interfacing, which diverts from respectively adds to the aforementioned theoretical discussions. This was done by way of two critical movements: proceduralising the interface as practices of interfacing and decentring the interface as milieus of interfacing.

In the first movement, Barad's concept of intra-action provided a radically relational and performative critique of interactionist notions of the interface. Instead of presupposing human and machine as pre-existing, interacting relata, they only come into being through the interface. Hence, such elements are not stable but are constantly reconfigured. This happens via practices of interfacing that, following Simondon's principle of montage, render those elements available for one another. Thus, the focus on interfacing uncovers the dynamism and fragility of efforts to interconnect formerly disparate entities. In the second movement, Simondon's concept of the associated milieu, decentres this perspective on the interface respectively interfacing, since it directs attention to the distributedness of the conditions, under which practices of interfacing operate. Here, entities to be interconnected rely on their embedding in the associated milieu, which in turn, conditions the way those entities can interconnect. This also implies a decentring of the subject as well as the object of interfacing. Following Barad, interfacing rests on a post-humanist account of material-discursive practice, where agency always denotes a distributed phenomenon, which is dispersed across human and non-human, material and discursive entities. This also calls for an extension and dissociation of the notion of interfacing from the human-machine interface towards wider milieus, such as political discourses, architecture or markets organised within an apparatus of innovation.

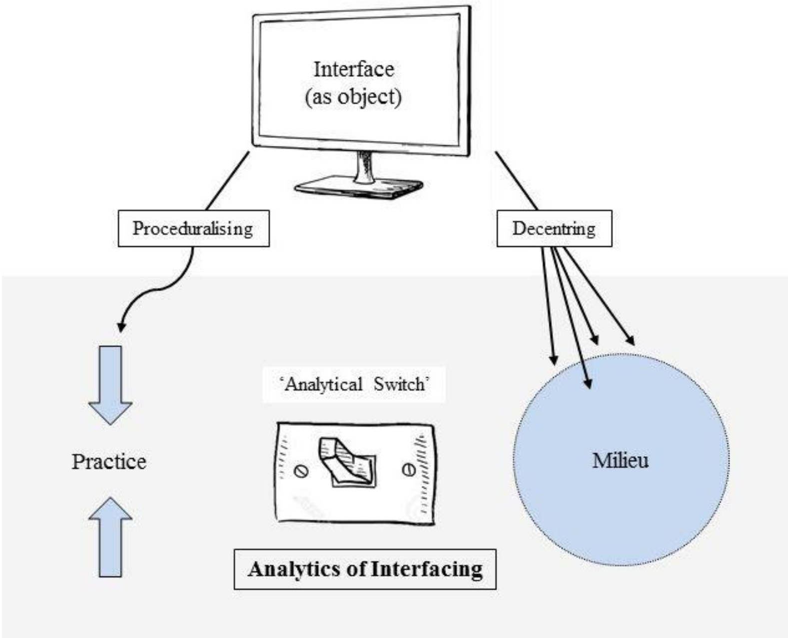

Figure 5 Analytics of interfacing

These are the essential components of my analytics of interfacing: practices and milieus of interfacing. While the theoretical groundwork above has introduced these notions separately, they are nevertheless tightly linked to one another. Their relation is comparable to a switch[33] (see figure 5), where the analyst can change perspective thus foregrounding particular aspects of empirical material. On one hand, the analysis of interfacing practices focuses on the diverse, often conflictual, mundane ways, in which formerly disparate entities are produced and

[33] I owe this figure of the switch to Jan-Hendrik Passoth's insistence on a lightweight sociology of circumstances, see Passoth 2019.

gradually rendered available for one another[34]. In doing so, it focuses on the open-ended, fragile ways in which powerful interconnections are made but also dismantled. For example, in the above case of the HRI experiments it is often the mundane and little things that bring efforts to interconnect robots and people to a halt. On other hand, analysing milieus of interfacing means to capture the diverse plurality of entities that play into practices of interfacing – often in unexpected ways. The totality of such entities conditions the possibilities and impossibilities present at a given time and in a particular place. Also such entities often have been placed or arranged prior to when practices of interfacing faced with them come in. For example, the research and innovation network mentioned above while still prone to change, has already been established before the experiments have started. They thus, to a certain extent, participate in installing the conditions or the material-discursive milieu of those experiments. The same goes for the wider discourses of innovation policy that also play a role in how such experiments are set up. After all, the experiments take place in a test apartment, a simulation of a home. This however does not mean that such milieus are inherently stable but that they, again, rely on practices of interfacing. At one point in time, the network had to be established, the willingness to cooperate had to be evinced, and diverting interests had to be (re)negotiated. Hence, analysing practices and milieus of interfacing means to constantly switch back and forth between both foci.

By analytically switching between practices and milieus of interfacing I will endeavour to capture both the heterogeneity and correspondence of the different ways in which the European apparatus of innovation interconnects robotics and elderly care. However, it also slightly changes how the notion of the apparatus is conceived. Based on Barad's reworking of this notion (Barad 2007, pp. 223–246), an analytics of interfacing views the apparatus as a circular theoretical figure, which on the one hand pays attention to how particular practices and milieus materialise an apparatus and its political structure. In turn and in addition to that, I will include the eventful dynamism of such practices and milieus of interfacing into the analysis.

> "Structures are apparatuses that contribute to the production of phenomena, but they must also be understood as thoroughly implicated in the dynamics of power: structures are themselves material-discursive phenomena that are produced through the intra-action of specific apparatuses

[34] This turn to mundane aspects of interfacing and a politics of innovation is inspired from a longstanding tradition of Feminist works in STS, which for example foreground otherwise neglected and disregarded care work in techno-scientific practice in general, see Puig de la Bellacasa 2011, 2017, and robotics in particular, see Suchman 2007, p. 217. In chapter 5, I will use this Feminist take on care work as an analytical lens to investigate the messy and mundane practices that surround and enable human-robot interaction in prototypical settings.

> of bodily production marked by exclusions. Structures are specific material configurations/(re)configurings of the world." (Barad 2007, p. 237)

This is precisely what connects an analytics of interfacing to Foucault's and Barad's apparative analysis[35]. Not only does the interconnection of RobotCare operate under the conditions of an apparatus of innovation and the new political urgency that it attaches to interconnecting society and technology. Also the realisation of this apparatus is itself a material-discursive phenomenon that finds its conditions in the performativity of practices and milieus of interfacing. For instance, the fragility of interconnecting robots and people in practice does not simply denote a deficiency with regard to the vision of RobotCare in innovation policy discourse. It rather signifies the performativity of the European apparatus of innovation itself and the project to interconnect RobotCare in it. Hence as said before, the empirical focus of this book is not to play off the material against the discursive but rather to tend to the apparatus in its operation, in its eventful, at times fragile realisation. This idea denotes the central theme that orders the case studies in the following chapters. In the first case study (see chapter 4) I will show how in the context of innovation policy, RobotCare, for over a decade, had to be laboriously infrastructured through coordinated action in work programmes and public-private partnerships. In the second case study (see chapter 5), I will show how in the context of an R&D robotics project roboticists and others constantly prototype interconnections between robots and test users – and often fail. Finally, in the third case study (see chapter 6), I will show how in order to transfer such interconnections into care practice a myriad of actors and their interests need to be produced and aligned. Hence, the dramaturgy of this book follows a path of realisation following the urging of an apparatus of innovation that, after all, is open-ended, conflictual, and contradictory at times.

3.2. Switching method assemblages

The broad make-up of this study together with the analytical task to switch between different angles has consequences for the methodical design of my research. The case studies of this book have not been picked for their own sake merely to study the emergence of RobotCare by itself. Rather, RobotCare stands for a broader phenomenon. It articulates a *techno-politics of innovation*. Hence, the central aim of this study is not only to show the making of RobotCare

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[35] Barad's notion of the apparatus denotes a critical extension of Foucault's work, in the sense that she appropriates his concept for the socio-technical analysis of techno-scientific phenomena, and consequently renders it available for STS research (while Foucault mainly restricted his analysis to the human sciences). However, there are theoretical resources in Foucault's work, which Barad has missed, see Lemke 2015, which could be considered as a future add-on to an analytics of interfacing as well.

through different practices and in different milieus but also to show how, in this process, a particular way of doing politics unfolds. Such an approach cannot solely rely on a pre-defined methodological frame nor can it simply trust piecing together disparate empirical material bottom up. It requires an in between position, where the merits of an in-depth analysis must be balanced against the aim to generalise findings beyond their strictly empirical reach. In other words, it requires methodological flexibility constantly switching between different combinations of methodical approaches. For this, I will draw on John Law's concept of method assemblage (Law 2004), a critical approach to method, which makes the basis for striking a balance between both of the above aims.

Methods do not simply represent the world. They play an active part in its production. Such is the central argument of John Law's book 'After Method' (2004). Unlike the title suggests it does not seek to abolish method altogether but rather to re-think it in terms of a 'method assemblage'. With this neologism, he envisages an extended role for methods in STS: as "a combination of reality detector and reality amplifier" (Law 2004, p. 14). Thus, on one hand, methods carve out particular properties, qualities, processes while, on other hand, methods come with particular 'hinterlands', that is, taken-for-granted but enabling assumptions about the world. "The hinterland produces specific more or less routinised realities and statements about those realities. But this implies that countless other realities are being un-made at the same time – or were never made at all" (Law 2004, p. 33). In other words, methods always create a space that remains unmarked but still is involved in the production of scientific realities. This makes method assemblage "a continuing process of *crafting and enacting necessary boundaries between presence, manifest absence and Otherness*" (Law 2004, p. 144). Furthermore, the notion of assemblage contains an important point about combining different methods:

> "So assemblage is a process of bundling, of assembling, or better of recursive self-assembling in which the elements put together are not fixed in shape, do not belong to a larger pre-given list but are constructed at least in part as they are entangled together. This means that there can be no fixed formula or general rules for determining good and bad bundles, and that (what I will now call) 'method assemblage' grows out of but also creates its hinterlands which shift in shape as well as being largely tacit, unclear and impure." (Law 2004, p. 42)

This definition of (method) assemblage is different from positivist approaches of combining different methods, such as, mixed methods. Those aim to find 'objectively better' combinations of methods in order to match reality 'out there' (Giddings 2006; Giddings and Grant 2007). By contrast, method assemblage seeks to create 'bundles', which grow out of the entanglement of methodical tools and empirical material. Distinctions between ‘good’ and ‘bad’ bundles thus arise *en passant* as a by-product of detecting *and* amplifying particular aspects of reality.

As a result, the three case studies of this book should not to be understood as giving a complete picture of the European apparatus of innovation ‘out there’. Rather, the chosen method assemblage detects its operation in particular material-discursive practices and milieus, while at the same time amplifying particular aspects of those practices and milieus in each case study. For this, each case study exhibits a differently assembled combination of methods. The aim of each of these case studies is to detect and amplify certain *modes of interfacing*, that is, particular, recurrent and in their operation more or less stable ways of rendering robotics and elderly care available for one another. It is these modes, which work as switches for connecting the focused case studies with the overall aim of the study to identify the political regime at work in all three case studies.

The first case study, ‘Infrastructuring RobotCare’, relies mostly on document analysis and a few interviews as a way to elicit the long-ranging, discursive formation of European innovation policy, in which RobotCare could become utterable as a topic (Foucault 2013[1982], 1970). I mainly analyse work programmes and other official documents within European innovation political discourse relevant to the matter of RobotCare from around 1999 to 2018. Here I trace the way robotics and elderly care have been interfaced as interconnected topics of R&D&I funding. In this analysis I mostly rely on official documents by the European Commission and the projects it has funded. Most importantly, this applies to the work programmes within the aforementioned timespan. It is complemented by text contained on websites, project brochures, reports, research agendas, and roadmaps. Additionally, I also refer to interviews that I have done with a few figures that have played a role in this process (namely with regard to the establishment and operation of the SPARC partnership).

The second case study, ‘Prototyping RobotCare’, uses (video-assisted) ethnography in order to articulate the localised and material characteristics of interfacing practices, for example, the eventfulness and mundane complexity of HRI experiments (Suchman and Trigg 1991). I investigate a European R&D robotics project[36]. Here, the analysis mainly comprises documents and video material collected during two ethnographic field trips in June and August 2015, which each lasted about one and a half weeks. The events observed during these two time frames where slightly different in nature. During the first event the team conducted ‘Pre-Tests’, where

[36] As previously stated, the name of the project as well as of the involved partners will be anonymised.

technical components of the tested robots still needed to be integrated and the test users were all considerably younger than the envisioned social group. The second event in August then comprised real ‘Tests’ with elderly users, whose feedback on the design and interaction experience were also reported to the European Commission. During both events I used cameras (both from myself and from the project), which I installed in different locations within the test apartment where the HRI experiments took place. Here, I captured not only the performance of the HRI experiments themselves but especially focused on the different practices before and after the experiments as well as ‘behind the scenes’ outside the test apartment. Additional to my ethnographic observations, I interviewed participants of the project, some during the field study, some afterwards via phone.

Finally, the third case study, ‘Translating RobotCare’, relies on semi-structured interviews with participants of a pre-commercial procurement project (Brinkmann 2014) in order to grasp the multi-actor constellations that participate in interfacing robotics and geriatric care. I mainly analyse interviews that I have conducted with the coordinating team at ECHORD++ as well as the members of one of the participating consortia called CLARC. It is one of two projects funded under the instrument of so-called ‘Public End-User Driven Technological Innovation’ (PDTI) with special focus on healthcare applications. These interviews[37] were conducted between June 2017 and April 2018, which denotes the beginning of the project’s last phase of small-scale testing. As far as participants were available, I tried to capture as many different perspectives within the project as possible. This ranged from the people at ECHORD++ coordinating the PDTI procedure, the roboticists responsible for developing the robot, a geriatric physician also involved in the development and testing as well as people from the health agency, who represented the hospital’s administration. Additionally, my analysis relies on official documents, such as the challenge briefs, to which CLARC and others answered with their project proposals, as well as publications by the ECHORD++ consortium. Moreover, I could get access to some non-official documents, such as the first draft of the physician’s proposal for a healthcare challenge[38].

Each case study, following Law’s notion of method assemblage, creates both presences and hinterlands. For each mode of interfacing I will focus on Robotcare from a slightly different

[37] The interviewees’ names will be anonymised.

[38] One of the characteristics of the PDTI process is that people from the application domains (here: geriatrics) come up with ideas about challenges addressable by robotics and only when that challenge is fixed, robotics consortia can apply for funds.

angle. I will do so not to get a more complete picture of the European apparatus of innovation 'out there' but rather to satisfy my research interest in carving out particular modes of interfacing RobotCare. Hence, by foregrounding particular aspects in each case I do not wish to negate that there are other layers to the empirical phenomena just outlined. For example, of course policy documents are written in material practice and negotiated face-to-face in conference rooms, HRI experiments are embedded within inter-organisational relations and networks, and the PDTI procedure results in particular material practices in the lab as well as in the designated demonstration site, e.g. the Catalonian hospital. It can be assumed that RobotCare is interfaced in all those instances, too. However, in order to keep a balance between breadth, i.e. number of case studies, and depth, i.e. amount of data collected for each case, it is important to strategically restrict the analysis on particular aspects of each case. At the same time, these modes are not restricted to only one case but are transferrable, thus, linking them to the other case studies. This results from my ultimate goal to analyse RobotCare within an apparatus of innovation, i.e. capture it on a societal scale. Therefore, I will organise the conclusion of this book not according to individual chapters but rather according to those modes mentioned earlier cutting across the three case studies. This is to show that these modes of interfacing exhibit more general aspects, which can be observed together as pertaining to an apparatus of innovation.

3.3. Three modes of interfacing RobotCare

The phenomenon of RobotCare has not come out of nowhere. Rather, it has emerged under new *political* conditions. In a first attempt to kick off this book's analysis, I have described the genealogy of population politics, which plays into the present situation of RobotCare. Recent initiatives of European innovation policy have effected a shift in how an ageing population becomes to be treated as a political problem. Here, the demographic 'fact' of over-aging is not primarily taken as a threat to societal order but rather put in economically productive terms as an opportunity for technological innovation. Strategies and interventions in this vein are thus not primarily motivated by securing a certain level of balance within the population but rather to innovate society with novel information and communication technology. To put it in Foucauldian terminology, the population politics has shifted from an apparatus of security towards an apparatus of innovation. The latter constructs and responds to the urgency to continuously interconnect technology and society, assistive devices and demographic change, business and the state, elderly people and the market in ever more ubiquitous and intimate ways.

The phenomenon of this book, RobotCare, denotes a paradigmatic case for this preoccupation with technological interconnecting. Its investigation in the following chapters will thus require an analytics able to uncover the manifold (political, social, technical, material, discursive etc.) processes and conditions, which have enabled it to emerge in the first place. In order to tackle this challenge, I have developed a two-sided notion of interfacing informing the ensuing analysis. Such an analytics rests on two heuristic attitudes between which the analyst must switch: on one hand, she must attend to manifold practices, both discursive and material, mundane and seemingly extraordinary, which participate in the endeavour to render robotics and care available for one another. On other hand, the analyst must also divert her attention towards the distributed circumstances, both discursive and material, in which practices of interfacing 'find' a favourable respectively difficult terrain to operate.

This analytical device, the analytics of interfacing, is organised within the apparative framework adumbrated above. Hence, the different milieus and practices of interfacing are not to be seen as isolated but rather as related to and organised by an apparatus of innovation. This has profound consequences for the design of and attitude towards the following case studies. Each of the following three chapters comprises an in-depth analysis of European innovation policy discourse (chapter 4), of human-robot interaction experiments (chapter 5), and pre-commercial procurement (chapter 6). Despite their differences in scope and scale, their analysis is oriented towards the same goal of uncovering the different modes, through which RobotCare has become interfaced and through which the activities that have contributed to it have been organised. At the same time, the aim is to tease out the specificities of each case, in that it contributes to this endeavour a particular line of argument and insight. This will be represented by labelling each of the studies with one mode, which highlights particular aspects of the interfacing practices and milieus detected in each case. In that sense, the analysis of European innovation policy discourse is motivated by showing the ways in which RobotCare has been *infrastructured* since the turn of the millennium. The case of human-robot interaction in a Scandinavian care facility is to carve out the *prototypical* nature of RobotCare and what that means for actors involved in it. Finally, the case of ECHORD++ allows for describing the manifold ways, in which those actors (both human and non-human) need to be profoundly *translated* in order to allow robotic technology to travel into care. Infrastructuring, prototyping, and translating are the three modes, through which the following case studies seek to uncover the operation of an apparatus of innovation, which, after all, will proof to be open-ended, conflictual, and contradictory.

4. Infrastructuring RobotCare

The starting point of this book was to take a step back and wonder why robotics and elderly care have become so close to each other within the apparatus of innovation. At first glance, the practices of caring for the elderly and developing robots seem to have absolutely nothing in common. Indeed, when considering the particular case of *European innovation policy* at the new millennium both topics were non-existent in its funding programmes. However, this has radically changed in the ensuing two decades. Not only have both topics, robotics *and* elderly care, gradually appeared on the agenda, they have done so in relation to one another. In other words, they have become components of a single overarching vision: to develop robots for assisting the elderly and their caregivers.

This chapter offers a genealogy of that interconnection. It investigates the discursive milieus and practices of interfacing, which have rendered that vision of RobotCare utterable within European innovation policy. Here, I argue that RobotCare has emerged due to the infrastructuring of particular *rationalities of interconnection*. Drawing on a Foucauldian understanding of rationality, I will show that European innovation policy discourse rationalises the interconnection of robotics and elderly care in three distinct ways: through *active and healthy ageing*, *ambient assistance*, and *technological innovation*. It is these three rationalities, which have enabled and constrained the way how both domains could not only relate to one another but also how they could emerge within this context. Based on this, I analyse the genealogy of those rationalities within particular infrastructural milieus: the EU's 'Framework Programmes for Research and Development' (FP), the Joint Programme for Ambient Assisted Living (AAL) and two innovation partnerships, the 'Partnership for Robotics in Europe' (SPARC) as well as the 'European Innovation Partnership for Active and Healthy Ageing' (EIP on AHA). Analysing the genealogy of RobotCare within these milieus allows to conceive interfacing within a specific mode of operation: *infrastructuring RobotCare*. Interfacing here means to establish new and reconfigure existing infrastructures of innovation policy, which enable and constrain the interconnection of technology and society in general as well as of robotics and elderly care in particular.

Based on this general argument, I organise this chapter in five sections. As a preparatory step, I will define the concept of rationalities of interconnection drawing on Foucault's work on power and governmentality. Additionally, I will specify the notion of infrastructures from a discourse analytical perspective as discursive milieus and practices (4.1). Following this brief heuristic orientation, I will analyse and elaborate each of the three identified rationalities within one corresponding infrastructural milieu. To begin with, I will investigate the EU's health and technology work programmes (within FP5-FP8[39]) and how in them active and healthy ageing emerges as an overarching theme. This theme interconnects funding areas of the health and technology related work programmes and thus renders elderly care and social robotics compatible funding topics (4.2). Furthermore, I will focus on the 'Ambient and Assisted Living' Joint Funding Programme and the way it interconnects formerly disparate discursive threads on Independent Living and assistive robotics. This infrastructural milieu selectively re-appropriates these two discourses and interconnects them via the rationality of ambient assistance (4.3). Finally, the last empirical section will turn to two innovation partnerships, which have been established both with regard to care and robotics. In both partnerships, robotics and elderly care are interconnected via the rationality of technological innovation, requiring each to subscribe to a transformative agenda and a call for partnering their formerly 'fragmented' communities (4.4). Based on the analysis of these three rationalities of interconnection and the infrastructural milieus, where they have manifested, I will carve out an infrastructural mode of interfacing, which runs through all of the three examples. This mode operates under the assumption of the 'not yet' seeking to install conditioned spaces of possibility, in which RobotCare can become not only plausible but also desirable (4.5).

4.1. Infrastructures 'in the making': a genealogy of rationalities of interconnection

This chapter deals with European innovation policy in a particular way. I am not merely interested in describing the history of how robotics and care became interconnected. Rather, I am interested in the *rationalities of interconnection*, which have enabled and constrained the way in which both topics were interconnected with each other. In analysing innovation policy in this way I employ a Foucauldian understanding of rationality (Foucault 2008; Barry et al. 1996; Lemke 2001b). In this context, rationality is defined as

> "… a discursive field in which exercising power is 'rationalized'. This occurs, among other things, by the delineation of concepts, the specification of objects and borders, the provision of arguments and justifications etc. In this manner, government enables a problem to be addressed and offers certain strategies for solving/handling the problem. In this way, it also structures

[39] I look at these work programmes from the 5th Framework Programme launched in 1999 until the most recent programme, Horizon 2020, which has been active since 2014 and which will continue until 2020. While I will mainly look at the contents of the work programmes, the framework programmes function as a kind of frame of reference. They denote an important means to structure not only the analysis but also the very practice of funding itself. Every new framework programme signifies the opportunity for funders to re-evaluate and re-configure their funding priorities and topics (additionally, work programmes are continuously revised during a single FP but with less consequences for the overall structure of the different funding areas).

> specific forms of intervention. For a political rationality is not pure, neutral knowledge which simply 're-presents' the governing reality; instead, it itself constitutes this intellectual processing of the reality which political technologies can then tackle." (Lemke 2001b, p. 191)

In this perspective, the three rationalities of interest in this chapter, ageing, assistance and innovation do not merely represent the world 'out there' but rather they produce that world in a particular way. Take the concept of Active and Healthy Ageing as an example. As I have shown in the previous chapter, this concept constitutes a new discursive register, which views demographic change not primarily as a threat but as an opportunity for technological and economic development. The knowledge contained in this concept is not rational in the sense that it grants access to the only reasonable way of taking political action *vis-à-vis* demographic change. Rather, it is *rationalised* in the sense that it *constitutes* particular problems (e.g. lack in care personnel) and *links* them to particular solutions (e.g. social robotics). Hence, the concept of rationality describes the rules of how government operates in a certain context at a particular point in time. In other words, it gives insight into how the world can be rendered *governable*. Given this understanding of government and rationality, the vision of developing robots for assisting the elderly and their carers could only become a discursive reality due to certain *rationalities of interconnection*, which have emerged (or at least appropriated) in the context of European innovation policy. In this sense, the genealogy of RobotCare will follow the different ways of how elderly care and robotics have been problematised and how their interconnection has been rendered plausible and desirable since the new millennium.

In the case of European innovation policy, such rationalities of interconnection are products of and situated within particular milieus: the EU's 'Framework Programmes for Research and Technological Development' (FP), the joint programme of AAL, and innovation partnerships. Such infrastructures organise certain practices of innovation policy, e.g. inviting tenders to apply for funding, creating a European marketplace of assistive technology for the elderly or coordinating whole fields of stakeholders as partnerships. I detect these activities mostly in documents such as official policy papers, research agendas, work programmes, websites or mission statements. This scope of texts is complemented by two interviews I conducted: one with an official of the euRobotics association and another with the innovation manager of a German robotics company, which plays an important role in policy activities surrounding European robotics.

This choice of material assumes a particular meaning of the term 'infrastructure'. Usually, infrastructures are conceptualised as "physical networks through which goods, ideas, waste, power, people, and finance are trafficked" (Larkin 2013, p. 327). There is an extensive body of literature in STS that investigates infrastructures through an ethnographic lens (Star 1999; Star and Bowker 2002). However, the present chapter approaches the aforementioned infrastructures from a discourse analytical perspective thinking about them as discursive milieus comprising distinctly organised statements[40]. In this sense, the present chapter detects and amplifies, what Larkin has called, the "poetics of infrastructure" (Larkin 2013). This means to attend not only to the technical function of an infrastructure but rather to "the means by which a state proffers … representations to its citizens and asks them to take those representations as social facts" (Larkin 2013, p. 335). Hence, I am insofar interested in these infrastructures as they harbour certain rationalised representations of why the interconnection of robotics and care might be plausible or even desirable.

4.2. Active and healthy ageing in the European work programmes

Active and healthy ageing is the first rationality of interconnection whose genealogy I will investigate within the European Union's 'Framework Programmes of Research and Technological Development' (FP[41]), i.e. within the respective multiannual work programmes containing the calls for contributions and project proposals. Here, I focus on the evolution of work programmes related to health as well as information and communication technology (ICT). These programmes form the infrastructural milieu, where to trace and analyse the ways, in which robotics and elderly care could become interconnectable. More concretely, I will look at particular topical units (i.e. 'Key Actions', 'Objectives', 'Challenges'), where robotics and elderly care are invoked as compatible areas of research and development (R&D). I will trace how such topical units appear, disappear and circulate in those work programmes. Analysing them in such a way gives insight into what European innovation policy expects from potential beneficiaries of funding (both, situated within care and robotics). In other words, I am interested in how the interconnection between robotics and care is *rationalised* and, in the process, gradually *infrastructured* through active and healthy ageing.

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[40] This has its limitations in that relying on official communications might paint an all too 'smooth' picture of their working. Also, analysing the way funding calls are organised does not allow for insight into the 'material' effects of such organisation, namely, the way this affects the design and operation of actual R&D projects. However, in chapter 5 I will attend to (parts of) the material practice in an R&D project funded under FP7.

[41] In the following, this abbreviation will be combined with the respective numbers representing the various instantiations of the EU's framework programmes. For example, FP5 will represent the 5th Framework Programme, FP8 will represent the 8th Framework Programme. The latter also bares the more widely known name 'Horizon 2020'. For the sake of consistency, I will however stick to numbering the different FPs as described above.

4.2.1. Prelude: the infrastructural milieu of the 5th framework programme

The FP5 signifies an important shift in how the EU organises and motivates its R&D funding. This is to say that, while robotics and elderly care are far from being seen as important funding topics within the FP5 as well as the FP6 (for this, see the next sub-section 4.2.2.), the FP5 already installs the conditions, which will later enable (and constrain) the interconnection of robotics and elderly care. In other words, the infrastructural milieu that has contributed to interfacing robotics and care dates back (at least) to the year 1999, when FP5 begins operation. This framework programme introduces a "[n]ew integrated problem-solving approach" replacing the former science-based approach (European Commission 2016a). This means that the funding agenda is not organised according to specific disciplines anymore but rather, differentiated by Key Actions[42] "integrating the entire spectrum of activities and disciplines" needed to solve a given societal problem (European Commission 2016a). This already becomes visible in a series of renaming that has taken place in the ICT and health work programmes after FP5. For instance, the FP4 was classified into disciplinary areas, i.e. 'information technologies', 'communication technologies', 'biotechnology' as well as 'biomedicine and health' (European Commission 2014b). By contrast, the FP5 started to integrated these research areas into thematic programmes, that is, the 'Information Society Technologies' and the 'Quality of Life and Management of Living Resources' programme (European Commission 2009a).

I argue that this shift played an important part in setting up the conditions for the interconnection between robotics and care to emerge[43]. Most importantly, the FP5 reconfigures the target values underlying the organisation of different funding areas ('scientific' goals FP4 vs. societal needs in FP5+). It also changes the scope of elements (or targets) which should be interconnected (members of a discipline in FP4 vs. science and society in FP5+). In this infrastructural milieu science and society are observed according to their *interconnectability*, i.e. their availability for integration into inter- respectively transdisciplinary units of funding[44]. Given this rationale, also the interconnection of seemingly different domains such as the development of robots and the care for the elderly not only becomes possible but potentially desirable. In the context of the EU's work programmes, we see that their interconnection begins with first efforts to align

[42] The EC's wording changes over time introducing other categories such as 'challenges' or 'objectives'. For an overview of how practices of priority-setting has evolved throughout the EU's FPs, see Andrée 2009.

[43] I suppose one could make the case that this form of "interdisciplining" [Interdisziplinierung] has helped establish a number of similar interconnections between particular fields in ICT and 'social' application areas, see Weber 2010.

[44] This shift towards interdisciplinary cooperation and challenge-based integration relates to a wider reconfiguring European science policy discourse in general, see Owen et al. 2012; Kearnes and Wienroth 2011; Kaldewey 2013.

research and societal needs under the theme of an Information Society but only condenses with the later establishment of another overarching theme: active and healthy ageing. Again, while the latter is not yet utterable as such, it nevertheless 'beenfits' from the infrastructuring of an "integrated problem-solving approach" (European Commission 2016a) within the FP5.

4.2.2. The information society in FP5 & FP6

The societal needs targeted by the technology-related work programmes within the 5th and 6th Framework Programme revolve around the vision of an Information Society. In such a society (digitised) information and knowledge is expected to become the main economic resource rendered available and exploitable by the development and proliferation of information and communication technologies. The main focus of the 1999 Work Programme lies on:

> "… *enhancing the user-friendliness of the Information Society*: improving the accessibility, relevance and quality of public services *especially for the disabled and elderly*; empowering citizens as employees, entrepreneurs and customers; (…) ensuring *universally available access* and the intuitiveness of next generation interfaces; and encouraging *design-for-all*. These issues are all taken up in a focused, coherent and complementary way in each Key Action." (European Commission 1999, p. 3)

In this quotation I see a number of interconnections important for this section: Information and communication technologies are positioned here as the main vehicle to tackle the social problem of *inclusion* or, to be more precise, to 'improve' existing services in order to better ensure their accessibility and quality for citizens, in particular the elderly and the disabled. Conversely, the problem of inclusion is configured by the vision of an Information Society. Whether someone can or cannot participate in society depends on that person's ability to access and to use information technologies. In this context, the elderly and the disabled are identified as an especially affected group. They are at risk of remaining 'outside' of such an Information Society thus rendering extra measures necessary to 'include' them, i.e. by making ICT more accessible to those groups. So, on one hand, technology-related work programmes are expected to orient their efforts towards social issues of accessibility. On other hand, this coincides with framing disabled and elderly people in terms of a deficiency *vis-à-vis* an Information Society. They are portrayed as not being able to use such technologies as the rest of the population and are thus targeted especially.

In this context, we can already observe first albeit sporadic endeavours to interconnect robotics and *health* care. In the 1999 Work Programme the Key Action of "Systems and Services for the Citizen" (European Commission 1999, p. 10) assembles robotics and care under the health related call ('Action Line') regarding "[n]ew generation *tele-medicine* services" (European

Commission 1999, p. 12, my emphasis). Tele-medicine denotes the remote provision of health care via information and communication technologies, which is often positioned as a means to secure the availability of care in remote rural areas[45]. In this particular call, tele-robotics appears as a designated technological component of tele-medical services that potentially reconfigures the provision of health care. The hope is that it would enable personalised care at a distance "at the point of need" (European Commission 1999, p. 12) thus lowering health care costs due to reduced hospitalisation.

Robotics and care are rendered available for one another under the concern of tele-*medicine*. This has consequences for how either of the two components feature in the ICT work programmes. First, it makes them part of a *medical* project geared towards treating sick people and their illnesses (often with longer-term conditions). While these diseases might be more prevalent in old age, the elderly constitute only one potential target among "persons with special needs" (European Commission 1999, p. 13). Furthermore, tele-medicine is interested in the elderly if at all *as patients* and their *health* care, thus, not so much with regard to their everyday lives and social care[46]. Second, tele-robotics only appears briefly in this common call, which, during FP5 and FP6, leaves the interconnecting of robotics and care confined to this 1999 work programme[47].

Within the 6th Framework Programme old age continues to feature as one target among others for research and development in information and communication technologies under the objective of "eInclusion" (European Commission 2003, p. 32). This call continues the approach of the Information Society theme towards technological development for the elderly. However, social care not to mention elderly care remain absent from these work programmes. The objective generally calls for efforts to "develop intelligent systems that empower persons with disabilities and ageing citizens to play a full role in society and to increase their autonomy"

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[45] For empirical investigation and critique of the practice and vision of tele-care, see Oudshoorn 2011; Pols 2012.

[46] It is important to understand the distinction between social and health care here. This distinction is not universal but specific to particular (national) legal frameworks. One prominent example is the British National Health Care Service, which defines both according to the specific needs that are attended to. Healthcare relates to "the treatment, control or prevention of a disease, illness, injury or disability, and the care or aftercare of a person", see British Department of Health 2012, p. 50. By contrast, social care focuses "on providing assistance with activities of daily living, maintaining independence, social interaction, enabling the individual to play a fuller part in society, protecting them in vulnerable situations, helping them to manage complex relationships and (in some circumstances) accessing a care home or other supported accommodation", see British Department of Health 2012, p. 50.

[47] In another call for "[s]ystems and services for independent living" situated within the same Key Action "tele-support" is mentioned but without any reference to robotics, see European Commission 1999, p. 13. In the subsequent Work Programmes the reference to tele-robotics disappears completely while concerns of independent living and tele-medicine remain albeit peripheral topics, see European Commission 2000, 2001b.

(European Commission 2003, p. 32). This again means that the elderly designate only one group among many in need of 'eInclusion'. The problem of inclusion continues to configure the way in which ICTs relate to the elderly and vice versa. Such technologies may entail, among other things, robotics as a possible component "to be integrated in assistive devices" (European Commission 2003, p. 32). However, such an explicit mention is a rare exception.

So, in the context of the ICT work programmes of FP5 and FP6 robotics and elderly care only sporadically feature in common calls. While the Information Society theme heavily invests itself in the interconnection of ICT and the disabled as well as the elderly in general this is yet without consequence for robotics as well as elderly care. This situation radically changes in the remaining two framework programmes and is mainly due to a new urgency attached to the societal challenge of an *ageing society*.

4.2.3. The ageing society in the ICT work programmes (FP7)

Starting with FP7 European funding policy attached an unprecedented urgency to an ageing society. This does not mean that the concern of ageing did not feature at all before. Already, the FP4 (European Commission 2001a) as well as the FP5 (European Commission 2009a) emphasised ageing as an important concern for R&D. However, they did so with regard to biomedical research and were thus inconsequential for early interconnections of robotics and elderly care. This changes in the course of FP7, where the concern of an ageing gets picked up in the ICT work programme first before the health work programmes follow in FP8. In the former, the ageing society forms the canvas, onto which R&D in ICT inscribes itself. Throughout all ICT work programmes of FP7, ageing is depicted as having a great impact on society and thus should be a major target for technological development.

> "… [A]geing is beginning to change the shape of labour markets and is already strongly influencing the needs for care and 'lifelong participation' in society. The ICT literacy of the above-65 age group will improve significantly in the next decade. This will *create mass commodity markets for well-being products and services* – and *unlock markets for assistive technologies* –, fuelled by an estimated EUR 3000 billion of wealth and revenues of the above-65 population." (European Commission 2009c, p. 72, my emphases)

In this quotation the phenomenon of ageing and, more specifically, the growing target group of the elderly is produced as the main driver for changing 'labour markets', for necessitating 'care' and 'lifelong participation'. In turn, the European Commission expects the impact of ageing on society to create new 'markets for assistive technologies'. Hence, economic and business opportunities associated with ageing are foregrounded here as the target value and outcome for developing new ICTs. Compared to the previous work programmes and their vision of an Information Society the above quotation signifies a shift of focus in at least two ways.

First, heralding an ageing society singles out the elderly as a particular population group, which is deemed in need of "assistive technologies" (European Commission 2009c, p. 72). They are not merely a special sub-group of "persons with special needs" (European Commission 1999, p. 13) anymore but they become *the* primary target group for research and development of ICTs. This shift in attention materialises in the promotion of independent living as a target value of the ICT theme as indicated by the new Challenge on "ICT for Independent Living, Inclusion and Governance" (European Commission 2007b, p. 50). While the aforementioned concern of inclusion places emphasis on the question of access to existing digital infrastructures and public services, the concern of independent living lies in the development of new assistive devices and systems specifically marketed to the 'the above-65 population'.

Second, this focus also means a change of the political agenda. The ageing population is portrayed not only as the primary target but also the main driver of R&D endeavours in digital technologies. This 'drive' is first and foremost "fuelled by an estimated EUR 3000 billion of wealth and revenues of the above-65 population" (European Commission 2009c, p. 72). The main concern is not merely to include the elderly into an Information Society by making 'more intuitive' ICT but rather to *cater to* and *exploit* an elderly population as an increasingly important *economic* factor. This echoes what I have earlier termed an opportunist register of innovation politics, through which demographic change is not primarily seen as a threat to society but as an opportunity for technological innovation and business (see chapter 3.1). The prominence of ageing in these work programmes materialises this register in infrastructural terms. It changes the way both technology and the elderly appear on the stage of European innovation policy[48] and it is in this context that the interconnection of robotics and care gradually attains reality.

While in the 2007 Work Programme robotics still merely features as one of many possible "underpinning technologies" (European Commission 2007b, p. 50) for measures to enable independent living of elderly people. This changes in the subsequent work programmes. For

[48] This does not mean that the concern of an ageing society simply replaces the one of an Information Society or that the latter would not contain any economic goals. Quite the contrary, the Information Society theme is still present in the 7th Framework Programme (albeit not as prominent as before) and also is committed to "enabling *sustainable growth and improving competitiveness*", see European Commission 2003, p. 6, original emphasis. What the 7th Framework Programme show however is the *foregrounding* and the *intensification* of these concerns in connection with ageing.

the first time, a call for "Service robotics for ageing well" (European Commission 2009c, p. 73) featured as central objective of the 2009 ICT Work Programme.

> "This objective focuses on service robotics for ageing, which is still a longer term research topics (sic) (…) [It seeks to achieve the] [i]ntegration and adaptation of modular robotic solutions that are seamlessly integrated in intelligent home environments and adaptable to specific user requirements for support to elderly people and their carers." (European Commission 2009c, pp. 72–73)

This marks a turning point in the establishment of RobotCare on the stage of European innovation policy. In order to understand how this call interconnects robotics and care we need to turn to the *specific* ways in which both components are reconfigured in order to become interconnectable in the first place.

To begin with, robotics is invoked here as *service* robotics and this already owes itself to a change in how robotics has appeared in ICT work programmes before. This work programme and its predecessors herald service robotics as a new kind of robotics, which will allow for the application of robots beyond the traditional sector of manufacturing (European Commission 2009c, p. 27). It links to the vision of robots "moving out of the shop-floor" (European Commission 2005a, p. 4) and into 'societal' domains such as elderly care. This discursive thread already surfaces at the end of the FP6 and materialises in the above quoted objective of 'Service robotics for ageing well'. Here, elderly care comprises a set of new problems for robot development. Milieus such as the care facility or the elderly's home are seen as "unknown environments" (European Commission 2009c, p. 72), which confront robots with unprecedented complexities produced by lay users, unpredictable events or otherwise changing conditions. Hence, elderly care arrangements are produced in this objective as a testing ground for a new kind of technology: *service robots*.

In turn, this also means that elderly care *produces* or at least *affords* new ways of doing robotics. This can be illustrated by the follow-up objective in the 2011 ICT Work Programme where the call is expanded to "Service and *social* robotics systems for 'Ageing Well'" (European Commission 2011, p. 71, my emphasis). This brings about a new emphasis on "affective and empathetic user-robotic interaction" (European Commission 2011, p. 72) as a target outcome. Here, the project of social and service robots becomes confronted with an expectation that has already been established in the previous FP5 under the theme of an Information Society. The challenge here is not only to make robots work in technical terms but also to adapt them to "user needs" (European Commission 2011). This confronts robotics with a whole array of new actors, such as, care service providers, insurance companies, housing organisations, relevant industry partners and public bodies (European Commission 2011, p. 72) producing new kinds of problems such as "user acceptance, adequate safety, reliability and trust as well as ethical considerations" (European Commission 2011, p. 72). Some of these at least potentially require completely different kinds of expertise (such as philosophy, psychology, nursing, law or business management). Hence, the societal challenge of ageing also affects the practice of robotics. It creates the need for kinds of research and expertise.

While the 2009 work programme and its predecessors have given us insight into the first instances where robotics and elderly care, at least discursively, interconnect, this intensifies with the introduction of Active and Healthy Ageing into the health work programmes of FP7 and FP8. It functions not only as a new topic but as an overarching reference point, with regard to which ICT and health work programmes must align themselves. This is consequential for the disciplinary scope invoked to talk about and act towards the challenge of ageing.

4.2.4. Active and healthy ageing in the health work programmes (FP8)

Within the health work programmes, the topics of ageing and care have long and predominantly been understood in biomedical respectively bio-technological terms. This is illustrated by the title of the FP6's health theme called "Life Sciences, Genomics and Biotechnology for Health" (European Commission 2005b). If ageing has become a topic at all in these work programmes it has done so under the umbrella of the life sciences. Ageing is configured here as a life phase, where certain illnesses and disabilities become more prevalent thus affording measures to care for and cure those diseased (European Commission 2014b; for the case of the FP4 and FP5, see European Commission 2009a). This has played into the fact that care is largely understood in medical terms, i.e. as *health* care. However, this focus on health care and ageing profoundly changes towards the end of FP7. This coincides with the adoption of Active and Healthy Ageing (AHA) as a "[c]ross-thematic" approach" (European Commission 2012, p. 7) aligning funding topics in health and ICT related work programmes. In the following, I will show how this has effectively changed the disciplinary spectrum of funding topics dealing with ageing towards ICT development and the technical sciences.

First, AHA as it is taken up within European innovation policy explicitly refers to the policy framework of 'Active Ageing' propagated by the World Health Organisation (WHO) in the early 2000s (World Health Organization 2002). This "positive vision on ageing" (European Innovation Partnership on Active and Healthy Ageing 2011b, i) effects a change in the political register of how ageing is treated as a problem of governance. Unlike previous 'alarmist' accounts of ageing (Katz 1992) the WHO constructs the elderly as a resource rather than a threat for society. This appreciation comes with the call towards policy makers for creating and enhancing the conditions for the elderly to be ‘active’ and productive in society.

Meanwhile, the emphasis on ‘activation’ is tightly connected to an expansion of what ‘health’ means hence opening the disciplinary gaze on old age from a purely medical point of view to various forms of (social) health sciences. The WHO’s policy framework was a response to ongoing discussions in the late 1990s on additional factors of the ageing process beyond physical health (World Health Organization 2002, p. 13). In this context, ‘Active Ageing’ does not only mean to be physically or mentally well in old age but also to be socially included in society. The healthiness of a person or group becomes synonymous with social inclusion and an active lifestyle. Here, the elderly’s independence is rendered an important target value for health policy, i.e. “the ability to perform functions related to daily living” (World Health Organization 2002, p. 13) and the elderly’s perceived quality of life. Hence, as mental and physical abilities decline in old age ‘independent living’ affords new measures and modes to assist and care for the elderly in their everyday lives (World Health Organization 2002, 37f.).

The WHO policy framework of Active Ageing only sporadically refers to assistive technologies. In contrast, the EU’s approach of AHA appropriates this vision and interconnects it with the imperative to develop innovative “ICT for health, independent living and active ageing provide ways to best tailor care services to the needs of older users” (European Innovation Partnership on Active and Healthy Ageing 2011b, 1). This has consequences for how robotics and care can interconnect. While this process was formerly confined to the ICT work programmes under FP7, it now travels to the health related work programmes in FP8.

Under the retitled ‘Health, demographic change and wellbeing’ theme (European Commission 2015c, 2016d) robotics appears within the challenge dedicated to “Advancing active and healthy ageing with ICT: Service robotics within assisted living environments” (European Commission 2015c, p. 29). The central concerns here do not revolve primarily around technical issues of robotic components, integration or other ‘robot problems’[49] but rather around collecting “[e]vidence for the benefits of service robotics … based on proof of concept and involvement of relevant stakeholders” (European Commission 2015c, p. 29). Robotic solutions are evaluated on the basis of the achieved “[r]eduction of admissions … in care institutions (…) [and] [i]mprovement in quality of life” (European Commission 2015c, p. 29). This continues in the 2016 Work Programme where robotics and elderly care feature within a cooperative action

[49] As, for example, the operation of robots in “unknown environments” of care as described earlier, see European Commission 2009c, p. 72.

between the EU and Japan focusing on robotic applications at home or in care homes (European Commission 2016d, p. 31). Such robotic systems should incorporate "the needs, interests and lifestyles of older people" (European Commission 2016d, p. 31).

This means that within the FP8 health-related work programmes focus on evaluative measures assessing the *effect* of robots on care practices and the elderly's lifestyles. There is, at least on the surface, no explicit reference to technical issues surrounding the application of robots in care. Rather, there is an even stronger emphasis on the interaction with users and their respective (culturally engrained) living environments[50] than in the previous calls of FP7 ICT work programmes. In turn, elderly care is not solely understood as a testing ground for service robotics but rather as a demonstration site for active and healthy ageing. Robots are, at least prototypically, seen as means to "tailor care services to the needs of older users" (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 1).

Another effect of this is that ageing and care is not seen as restricted to the disciplinary scope of (bio-)medicine anymore. Under the impression of the WHO's framework of Active Ageing, the work programmes shift their focus from questions of health care to questions of 'assisted daily living'. This renders available manifold entry points for robotics to intervene into the everyday life of the elderly and the services of their carers. Consequently, the FP8 health work programmes witness an unprecedented amount of ICT related calls. Hence, the biomedical gaze on elderly care and ageing is now complemented, if not at times displaced by, technical disciplines, such as, engineering, computer science, and robotics. Here, the 'cross-thematic approach' of Active and Healthy Ageing serves as a new rationality of interconnection that allowed such topics and disciplines to travel from the health to the ICT work programmes – and *vice versa*.

4.2.5. Interfacing elderly care and social robotics

Drawing on the 7th and 8th framework programmes, one can observe that robotics and elderly care become interfaced following a particular rationality of interconnection: ageing in general and Active and Healthy Ageing in particular is perceived here as *the* overarching concern, which affords new ways of infrastructuring EU funding policy and interconnecting ICTs with care services for the elderly. In this context, service respectively social robotics and elderly care emerge in the EU's work programme and they do so in relation to one another. On one hand,

[50] In chapter 5 I will investigate this phenomenon more by drawing the attention to the practice of user experiments. Here, it shows that within the practice of user experiments human-robot interaction entails further procedures of interfacing rendering people, robots and 'their' environments available for one another.

the concern of ageing opens up avenues for robotics development to test a novel paradigm in care environments. Care features as the model environment for confronting service robots with complexities of human-robot interaction ‘in the wild’. This articulates ‘social’ factors in robotics research and development requiring to render interaction with robots more intuitive and natural for ‘lay’ elderly users. On other hand, Active and Healthy Ageing foregrounds the social aspects of health emphasising the importance of the elderly’s everyday life and social care. This makes independent living but also overall benefits to care systems a requirement for robotics funding. Here, robots are not only configured as a distant research outcome but also as prototypes, which should demonstrate beneficial outcomes for the provision of elderly care. Acceptance by users and positive effects on the quality and efficiency of care form an important passage points (Callon 1986), through which robots’ social and economic viability *vis-á-vis* elderly care can become plausible. As a consequence, the promise to assist elderly people in their everyday lives has led robotics and other technical disciplines to complement, if not at times displace, biomedicine and bio-technology when it comes to tackle challenges of ageing.

Before Active and Healthy Ageing was introduced in 2012 and especially before the FP7, neither elderly care nor robotics nor their interconnection have played a significant role. Hence, it must be emphasised that this overarching theme does not simply link two pre-existing topics, it *interfaces* them. This means that it *produces* robotics and elderly care on the agenda of European innovation policy and at the same time gradually *reconfigures* them into mutually available funding areas. This is due to persistent efforts to infrastructure a certain rationality of organising and prioritising R&D topics. Here, especially the FP5 has played a crucial role in installing the conditions for the inter- respectively transdisciplinary interconnectability underlying the overarching theme of Active and Healthy Ageing in FP7 and FP8. Hence, this theme does not simply signify a new topic, a new kind of rhetoric but rather it realises a particular rationality of interconnection, which has gradually re-structured how topics, such as elderly care and robotics, and their interconnection could become utterable as components of a single vision: to develop robots for assisting the elderly and their caregivers.

4.3. Ambient assistance in the AAL programme

This vision of robots assisting the elderly in their day-to-day-tasks has been established within an additional infrastructural milieu, the Joint Programme of Ambient Assisted Living (AAL Programme). It gives rise to another rationality of interconnection, ambient assistance, which has played an important role for how robotics and care could become interconnectable within European innovation policy.

4.3.1. The infrastructural milieu of the AAL programme

The Ambient Assisted Living Joint Programme was founded in 2008 under the umbrella of the 7th Framework Programme and continued under the Horizon 2020 programme. The second instalment of the programme was renamed '*Active* and Assisted Living'[51]. This follow-up programme continued its mission to enhance the quality of life of elderly people through assistive ICTs. What sets this discursive infrastructure apart from the work programmes described above is that it is

> "… an *innovation programme* (as opposed to purely a research programme) unifying national efforts and allowing companies to provide relevant solutions to existing and emerging user needs across Europe. (…) There should be a stronger strategic focus on <u>creating the marketplace</u> in which products and services can flourish rather than on the development of products and services per se." (Busquin et al. 2013, p. 20, original italics, my underlines)

This statement stems from the final evaluation document of the first funding period that sets out the future agenda of the second programme. It indicates the general rationale of the AAL programme, namely to pool national resources on the European level in order to fund innovation activities. Here, the programme relies, on one hand, on a market push 'allowing companies to provide relevant solutions' and, on other hand, on a market pull asserting that there is indeed growing demand for AAL products due to demographic change. Hence, the AAL programme also manifests what I have previously described as an opportunist register of innovation politics *vis-à-vis* demographic change. It views an ageing society not as a threat but rather as an opportunity for market exploitation and development of assistive ICTs. It translates this assertion into the infrastructural mission of pro-actively "*creating the marketplace*" for such technologies (AAL Programme 2014, p. 20, my emphasis). For this, the AAL programme not only funds particular projects, but also promotes the establishment of a "broad AAL Community" (AAL Programme 2014, p. 5) including not only research bodies and companies but also end-user organisations. It marks a difference with regard to the EU work programmes, where the focus lies more on the technological task of developing and demonstrating robots in elderly care. By contrast, the AAL programme sees this as requiring a more strategic and, incidentally, industry-oriented approach.

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[51] In the following, the abbreviation 'AAL' refers to *both* instalments of the joint programme. The renaming of the programme points to the interfacing of different rationalities and infrastructures. In this case, the AAL programme increasingly aligns with the overall European approach of Active and Healthy Ageing, namely with the European Innovation Partnership on Active and Healthy Ageing, see Busquin et al. 2013, p. 20.

4.3.2. ENRICHME: assistive robots in ambient care arrangements

In this context, the interconnection of elderly care and robotics is framed by ambient assistance. This rationality posits the elderly's need for a broad range of assistive ICTs in their homes and within 'networked' care arrangements. It draws together assistive robotics and a particular target value for the care and life of elderly people: independent living. I will show this by way of a robotics project called ENRICHME[52], a project which aims to realise that vision by combining assistive robotics with a 'smart home' environment supporting "the elderly to remain independent and active for longer" (ENRICHME consortium 2015b). The project aims to validate different scenarios in 'AAL home laboratories' and 'Elderly Housing facilities' in three different European countries.

In the following, I am not so much interested in the actual operation of the project rather than in the overall approach. The question is how it discursively interconnects particular values of elderly care and the technology of assistive robotics. For illustrating this, I take one of the project's scenario descriptions as this gives insight in how this project positions elderly care and the ENRICHME robot platform *vis-à-vis* one another[53].

> "Today Susan has been doing some spring cleaning in her house, but this seems to have been a little too demanding than usual. By regularly monitoring her physiological parameters and motion activities, ENRICHME detects that Susan is disoriented and in an apparent state of confusion. She took the (RFID-tagged) mop from the closet and replaced it there several times, which is unusual. It therefore decides to intervene, exploiting advanced Human-Robot Interaction techniques, to calm her down. The robot recommends her to take some rest, and accompanies the old woman, who still feels a little lost, to her bedroom, paying attention she does not trip over some cleaning tools left on the floor. At the same time, ENRICHME alerts her doctor, flagging also the most recent monitoring data for later analysis." (ENRICHME consortium 2015a)

This scenario stages the elderly person, Susan, as living alone while framing this in terms of her preference for "self-sufficiency" (ibid.). 'Independence' is configured here as relative autonomy from human help. It becomes the central tenet, on which a good way of ageing relies.

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[52] The project is not directly funded by the AAL programme but nevertheless generally subscribes to the rationality inscribed into the AAL programme. ENRICHME is a project funded under the call "Service robotics within assisted living environments" within the Horizon 2020 health work programme, see European Commission 2015c, p. 29. This overlap with the previously analysed milieu of the EU's work programmes again points to the fact that the cases investigated in this chapter are highly connected with one another. The rationality of interconnectability does not only apply to robotics and elderly care but also to the cross-coordination between different kinds of funding programmes within European innovation policy.

[53] Scenarios are an important vehicle for not only legitimising but also testing robots in R&D projects such as this one. I will investigate the role of scenarios and their function as vectors of staging robots for care in chapter 5.

In this context, human care is something that must only be triggered in specific occasions, that is, when anomalies occur in the everyday life of Susan. Care is not restricted to the care home or a hospital but rather a "(n)etworked" phenomenon (ENRICHME consortium 2015c), which extends into Susan's home and which is mediated by the ENRICHME platform as well as the ambient sensors and databases it connects to. In particular, the ENRICHME platform becomes the means by which the single elderly person can be cared for at a distance enabling Susan to stay at home and to live alone. 'Care' is configured as maintaining a regular and continuous mode of monitoring and surveillance of the everyday activities of the elderly person. The ENRICHME robot can then intervene at the point of need via advanced "Human-Robot Interaction techniques" (ENRICHME consortium 2015a). These relate to specific tasks such as escorting Susan to her bedroom or informing her doctor.

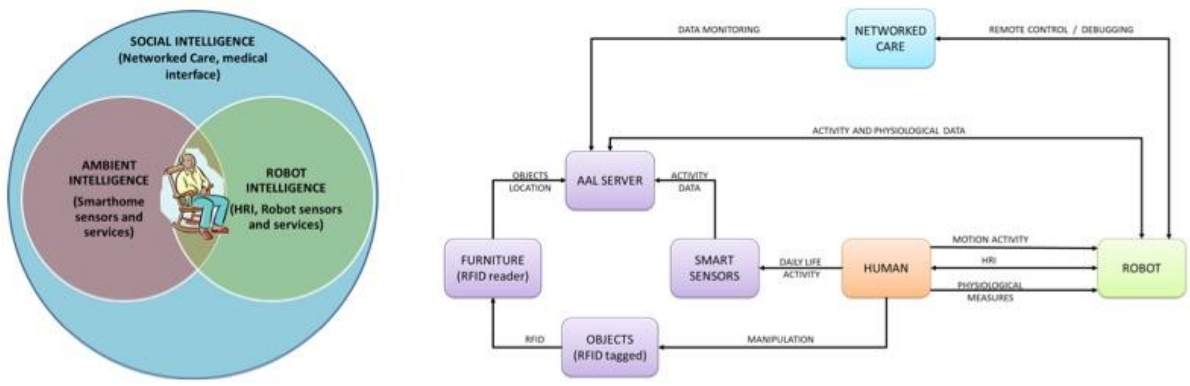

Figure 6 Concept sketch of the ENRICHME project (ENRICHME consortium 2015c)

In this vision, networked care is held together by "Ambient Intelligence"[54] (ENRICHME consortium 2015c) comprised of manifold technologies such as sensors, RFID-chipped objects and an 'AAL server' (see figure 6). The AAL system integrates human and robot within a smart home environment and, at the same time, interconnects them with the wider care network. This means that "formal and informal caregivers, friends, medical staff" (ENRICHME consortium 2015c) can access data and statistics of the user as well as the robot (e.g. for debugging it) and take action accordingly. In the scenario above the doctor was not only alerted but, at the same time, supplied with "most recent monitoring data for later analysis" (ENRICHME consortium

[54] This notion of ambient technologies taken up within the AAL programme can be traced back to the 6th Framework Programme (i.e. before the foundation of the AAL Joint Programme). Here, *Ambient Intelligence* is defined as a set of networked, novel technologies and systems allowing "ALL (sic) citizens to access IST [Information Society Technology] services wherever they are, whenever they want, and in the form that is most natural for them", see European Commission 2005a, p. 73. In this context, Ambient Intelligence affords to networking and embedding of digital technology into people's lifeworlds and everyday objects, see European Commission 2005a, p. 73.

2015a). The project's self-representation in figure 6 envisions robots, the home, caregivers and elderly people as mutually assisting components of a networked care system.

Now, the example of the ENRICHME project exemplifies how within the vision of AAL elderly care and robotics can interconnect. In fact, I argue that, in order to be able to speak about and act towards their interconnection, the AAL programme has *selectively* re-appropriated and rendered compatible two formerly disparate discourses, *Independent Living*[55] and *assistive robotics*. In particular, AAL extracts a highly specific notion of assistance from both of these discursive threads, which bares great consequences for how robotics and especially care could become compatible within the AAL programme. In the following, I will give a short account of each of the two discursive threads (starting with Independent Living) and their (re-)appropriation within AAL discourse.

4.3.3. Independent living: elderly care as personal assistance

Independent Living is not simply an invention by the AAL programme but rather denotes an emancipatory philosophy rooted in the US American disability movement (Martinez 2003). This movement has called for an extensive problematisation of social (and material) structures thought to hamper the participation of disabled and elderly people in everyday life (Morris 2004, pp. 428–429). Some of these critiques have explicitly found their way into government policies (Morris 2006) and, as described above, also into the innovation programme of AAL. The latter talks about independent living (lower case!) but lacks any explicit reference to the conceptual and political roots of Independent Living (upper case!). I argue that 'rendering elderly care available for robotics' here means to *selectively* appropriate and reconfigure *particular* elements of the Independent Living discourse[56] by especially picking up the concept of *Personal Assistance* as a model for attending to the elderly[57].

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[55] In order to distinguish between AAL's notion of independent living *vis-à-vis* its previous meaning within the disability movement I will spell the former with lower and the latter with upper case initials.

[56] It is important to note here that the following analysis means a trade-off between capturing the particular discursive logic of Independent Living (its political concerns) and, at the same time, following the specific research interest at hand. Hence, I will not attempt to capture this discourse's complete range and supposed heterogeneity but rather orient myself and the analysis towards the AAL's specific 'access' to this discourse. In turn, this does not mean that I will completely restrict myself to this specific entry-point. Rather, I will show how this 'access' is itself *selective* and, thus, *reconfigures* the discursive elements in question.

[57] As adumbrated above Independent Living is not restricted to elderly people but aims to speak for the disabled in general. In the following however, I will only speak about 'the elderly' while remaining cognizant of that the concept and philosophy of Independent Living and Personal Assistance actually comprises other groups considered 'disabled' as well.

Personal Assistance emerged within the Independent Living discourse as a critical vehicle against and counter-model to institutionalised forms of care (Watson et al. 2004; Morris 2004). According to this discourse, the needs of the elderly were not realised in institutionalised settings of care such as care homes or hospitals. Such places were deemed to operate along medicalised models of disability (*vis-à-vis* the 'normal') and paternalistic assumptions about the elderly and their ability to determine what assistance they 'really' need (McLaughlin 2006, cited after: Gibson et al. 2009, p. 319). Thus, the 'care system' is seen as an inadequate or at least deficient institution to foster the *independence* of the elderly, because it subjectifies them as a powerless group of care *receivers*[58] (Morris 1997). 'Independence' is understood here not as complete autonomy from outside help but rather as "having control over how help is provided" (Morris 1997, p. 56). What is 'good' for the elderly person should thus not be determined by care professionals but by the individual's choice itself. This narrative is situated within the wider disability movement and its basic emancipatory and participatory call for "nothing about us without us" (Charlton 2004), a call for self-determination and particiaption in quest of equal rights for disabled including the elderly.

Within this discourse, a particular thread of discussion has argued for "consumer-directed" assistance (Gibson et al. 2009) invoking the market as the enabling force to allow elderly people to attain the kinds of services they 'really' need (Ratzka 2002). The means by which the elderly can be empowered is to strengthen their consuming power and to broaden the availability of assistive services and devices on the market. This becomes especially apparent in the call for direct payments to elderly consumers as a way to finance access to assistive technologies (Ratzka 2002). One of Ratzka's central arguments is that in order to effect a user-friendly change in available assistive technologies, one needs to equip those in need with adequate spending power:

> "With cash in hand disabled people would be recognized as customers. Product functionality and design, information and advertising would be geared to our needs. Producers and distributors would receive market signals directly from users resulting in more competition and innovation." (Ratzka 2003)

Hence, by positioning Personal Assistance against institutionalised forms of care this branch of the Independent Living discourse introduces a specific rationality of how one should attend to the elderly. First, this rationality switches from a medical to an *economic* register, as shown in

[58] This representation of the elderly looks back to a long history as shown by Katz' genealogy of the almshouse and its configuration of the elderly as a problematic, passive, and unproductive population group, see Katz 1992 and my discussion in chapter 3.1.

Ratzka's quote above. The market is now the arena in which the elderly can make themselves heard via 'market signals'. The concern for equal rights and participation becomes a question of 'more competition and innovation'. The elderlies are seen not as patients but as consumers 'with cash in hand'. Second, this introduces a different logic with regard to how care is understood. Instead of being an ongoing process, care is seen here as a *portfolio of recombinable assistive services*, whose use is governed by the market and can thus be discontinued more or less at any time. Third, Personal Assistance displaces the socially distributed and, hence, uncontrollable character of institutionalised care settings towards situations in which everything and everyone can be negotiated one-on-one. In other words, it seeks to replace care's supposedly multiple and cooperative sociality with a *dyadic, personal relationship between the assisted and the assistant*[59].

In order to show how this rationality differs from (institutionalised forms of) care I invoke Annemarie Mol's distinction between a 'logic of choice' as opposed to a 'logic of care' (Mol 2008, pp. 74–79). The former implies care as a matter of choosing the right personal assistant. It rests on choice in the sense that care can be modified (the duration and nature of assistance) and, consequently, discontinued at nearly any time. It implies a momentary transaction (of money for service) between a provider and consumer of that assistance. It implies a direct commodification of care as a particular *assistive service*. In contrast, Mol argues that

> "Care is a process: it does not have clear boundaries. It is open-ended (…). … [I]t is a matter of time. For care is not a (small or large) product that changes hands, but a matter of various hands working together (over time) towards a result. Care is not a transaction in which something is exchanged (a product against a price); but an interaction in which the action goes back and forth (in an ongoing process)." (Mol 2008, p. 18)

When revisiting the earlier example of ENRICHME, we see how this particularly technologised and marketised logic of choice is re-appropriated within the AAL discourse. Care is understood here as a recombinable collection of assistive services and devices available for discontinuation at any time. *Care becomes assistance* (Krings and Weinberger 2017). This notion of assistance is effectively translated into the call for lowering costs and reducing "avoidable/unnecessary hospitalisation" (European Innovation Partnership on Active and Healthy Ageing 2012a, p. 4) by way of monitoring or assisting technology such as robots. It connects the bio-political worries about economic burdens due to demographic change with the imperative to create a

[59] This, of course, does not mean that *empirically* there are no personal relationships in care settings but rather that the personal duality of assistance is *discursively* positioned as a vehicle vis-à-vis care.

market place of assistive technologies for the elderly population, while at the same time legitimising this endeavour with the latter's supposed independence and empowerment.

4.3.4. Assistive robotics: elderly care as human-robot assistance

While technology comes in rather late in the Independent Living discourse, robotics targets elderly care from very early on at least as a potential application area for robotic assistance[60]. The following section will shed light on how this discourse of assistive robotics configures elderly care and how this relates to a paradigm shift in robotics.

Among the first roboticists, Joseph Engelberger imagines robots "aiding the handicapped and the elderly" (Engelberger 1989, p. 210). Engelberger is considered one of the pioneers of robotics, for both industrial and service applications (Engelberger 1989, 1983). Interestingly, in his book on service robotics he positions the application of assistive robots in care *vis-à-vis* institutionalised forms of care, at a time when the actual application of such machines was still considered a far-off vision.

> "No, the robot will not be a practical nurse; but a robotized private abode will be so much more desirable than being in a $25,000 to $40,000 per year nursing home, doomed to an elephant's burial ground, smelling urine unto death, and contemplating penury before blessed surcease." (Engelberger 1989, p. 217)

Being assisted by robots in a 'robotised private abode' is positioned as a more desirable alternative to the, in his eyes, disastrous conditions in nursing institutions. While Engelberger does not elaborate his depiction of institutionalised care, he gives a discussion of how robots could be useful to the elderly and how they might even be preferable to human caregivers. This relates to particular tasks, such as 'food preparation' or 'social interaction', certain robotic capabilities, such as 'dialog' or 'grasp', and more general characteristics of robots that render them desirable, such as the fact that robots do not need "personal time" (Engelberger 1989, p. 215) or could sustain the elderly's "unrelenting loquacity" (Engelberger 1989, p. 216). This rather technical and condescending tone is just to show that while in principle this opposition to institutionalised care settings converges with what I have described in the Independent Living discourse, its discursive milieu is entirely different. While the Independent Living movement attaches an emancipatory drive to its critique of care, assistive robotics rather views elderly care as bearing "so many opportunities for robotic aides" (Engelberger 1989, p. 210). Hence,

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[60] So, in retrospect, the introduction of elderly care as a testbed for robotics in the EU's work programmes, as described in the previous section, could rely on already existing 'availabilities', that is, narratives and technological developments, at least on the part of robotics.

robotics 'accesses' elderly care in a specific way, which mostly emphasises opportunities for technological progress.

Elderly care serves as an appealing *testbed for a new paradigm of robotics*. Here, the focus on robotic assistance marks an epistemic and technological shift in robotics. While traditionally robotics was mainly concerned with the development and application of industrial robots operating in closed factory cages, assistive robots are explicitly oriented towards lay user interaction. This produces a range of new requirements for robots and, incidentally, new ways of doing robotics often subsumed under terms like "new robotics" (Schaal 2007) or "Advanced Robotics" (European Robotics Technology Platform 2006, p. 3). This is due to the fact that a setting such as a household if compared to the factory production line constitutes a much less controlled and hence, more chaotic environment[61]. This makes a difference for robot development, because in order to interact with humans in such use contexts roboticists must engineer robots able to operate as "independent entities that monitor themselves and improve their own behaviours based on learning outcomes in practice" (Matsuzaki and Lindemann 2016, p. 501). Hence, the assistance of lay users in settings like a care home or a 'private abode', affords *new levels of autonomy* on the part of the robot, which must proof itself in more or less unstructured user environments.

Effectively, centring on the concern of assistance leads to an *intensification* and *demarcation* of the very problem of *human-robot interaction*. Almost simultaneously with the formation of service robotics in the course of the 1980s and 1990s fields such as Human-Robot Interaction (Schultz and Goodrich 2012) and, a little later, Social Robotics (Breazeal et al. 2008; Fong et al. 2003) emerge. These fields focus on either building robots fit for social interaction with users or using those machines to understand (human) cognition or a mixture of both. These fields conceptualise social assistance largely as a *dyadic interaction* between user and robot using *psychologised models* of action (Bischof 2015, p. 202). Especially in the context of social robotics, protagonists claim to strike up novel kinds of personal relationships with robots. Social roboticist Cynthia Breazeal, for instance, understands HRI between robot and human as an infant-caregiver relationship, where the robot learns from the latter through imitation learning and mimicry (Breazeal 2002; for a critique of this, see Weber 2005). This approach is heavily influenced by developmental psychology (Breazeal 2002, pp. 27–37). Hence, contextual

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[61] The distinction of controlled vs. uncontrolled is a field term that has to be understood in relation to the specific task of developing robot systems. Even slightest variations and contingencies such as a change in lighting can mean the system's breakdown. This, in turn, does not mean that in practice robots are developed in completely uncontrolled environments as I will show in chapter 5.

aspects of interaction such as social roles or institutions are mostly absent from studies of HRI and social robotics (Meister 2014).

Issue to be addressed	Current interventions/ technologies developed to meet needs	Robots with functions to address needs
Functional decline		
Mobility	Wheelchairs Walkers Canes and walking sticks Transportation services and taxis Mobility Scooters	Robotic wheelchairs [57] Guido [58]
		AILISA [60] Ri-man [153]
		Care-O-bot [61] Pearl [62]
Bathing	Home care services. Walk in shower Installation of support rails Non-slip bath mats	HRIB (Robotic bathtub; [63]
Toileting	Home care services Mechanical toilet seat [56]	a
Meal preparation	Home care services (e.g. meals on wheels)	MOVAID [154] Care-O-bot[61]
Housework	Home care services	Roomba (Robot vacuum cleaner) [57] MOVAID -changing beds and cleaning kitchen [154] Pearl [62]
Shopping	Home care services Online shopping	a

Figure 7 Table showing different 'needs' in healthcare and robotic 'solutions' (Robinson et al. 2014, p. 579)

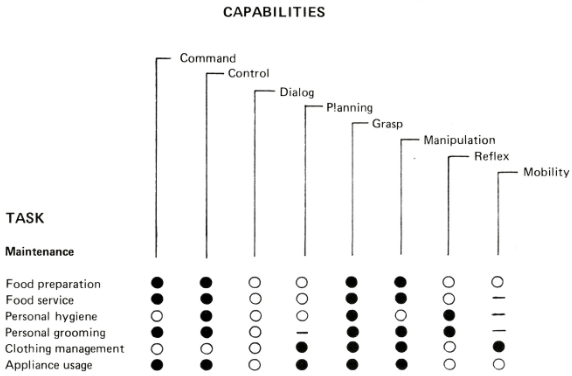

Figure 8 Table pairing certain tasks in elderly care and robotic capabilities (Engelberger 1989, p. 212)

This leads us back to the question of how exactly this discourse features care. When attending to the specific access of the assistive robotics discourse on elderly care we can see that robotics configures care with regard to particular *assistive tasks* respectively robotic capabilities specialised to fulfil such tasks (see figures 7 & 8). This is not only true for early examples of service robotics (Engelberger 1989) but rather constitutes a central design philosophy in assistive care robotics. In order to render itself relevant to elderly care, robotics identifies distinct everyday "problems that older people face" (Robinson et al. 2014, p. 577), which can then supposedly be met by using specialised robotic capabilities, e.g. computer vision or object manipulation[62]. Also in the previous example of the ENRICHME project this rationality of developing robots for care persists. The scenarios of that project show that the robot is expected and designed to fulfil very specific tasks in the everyday environment of elderly people, such as providing walking support, entertainment through games, or finding the user in the home according to monitoring data (ENRICHME consortium 2015a).

4.3.5. *Interfacing independent living and assistive robotics*

In this section, I have shown that in order to take robotics and elderly care as interconnectable, AAL renders available two disparate discourses on Independent Living and Assistive Robotics available for one another. What is striking about these two discourses is that, at first glance and within particular threads of discussion, they seem to have developed in similar directions throughout the past four to five decades. This is despite the fact that they are part of two largely

[62] This is, namely in the area of assistive robotics for the household, associated with the engineering of particular robotic arm or hand movements. Hereming1y 'mundane' actions such as 'grasping' require tremendous investment not only technologically but also financially, see Bose and Treusch 2013.

different domains, one rooted in the US disability movement, the other gradually developing out of the engineering discipline of industrial robotics.

In both cases, there seems to be a discontent with established, institutionalised settings of care, be it by criticising their paternalistic structure or by depicting the supposedly disastrous conditions for the elderly in (public) care facilities. Also, both discourses reconfigure care as a dyadic, intersubjective relationship while ignoring or actively fighting institutional dimensions of care arrangements in order to redistribute power towards the (disabled) individual. This may be for political reasons as a vehicle for empowerment strategies or for epistemic reasons, namely, as a way to describe and evaluate the interaction between the robot and a human user. Finally, care appears in both cases as a set of dissectible tasks or services, which can be selected and recombined almost at will by the user or the roboticist.

This is not to say that these two discourses talk necessarily about the same things. Rather, these elements are situated within largely disconnected milieus. However, this also does not mean that these two discourses talk about completely different things. Rather it means that their supposed compatibility denotes the interfacing effect of the AAL programme and the milieu of European innovation policy at large. Here, the critique of institutionalised care, most explicit in the Independent Living movement, is reconfigured into a vehicle for displacing care towards the home, consequently, delegating it to ambient assistive technologies. Here, the AAL programme in particular interfaces the project to make European care systems 'more cost efficient' with the rationale of enabling the elderly to remain 'independent for longer'. Care in this vision is not anymore about a continuous process but rather about technologically triggering *assistance* only when needed. Finally, the AAL programme interfaces the Independent Living's emancipatory (or market-based) drive for self-determination with assistive robotics' promises to provide elderly people with physical and social support compensating their 'handicap'. It is this rationality of ambient assistance, which has rendered the project of creating a new AAL market discursively possible. An innovation programme that makes "independent living an option for everyone" (AAL Programme 2014, p. 3).

4.4. Technological innovation in European innovation partnerships

There is a third rationality of interconnection, which has played a major role in rendering robotics and care interconnectable: technological innovation. In this section, I investigate this rationality within the milieu of innovation partnerships, the public-private 'Partnership for Robotics in Europe' (SPARC) and the European Innovation Partnership on 'Active and Healthy

Ageing'. The establishment of these partnerships in particular and the proliferation of innovation partnerships in European innovation policy in general relates to broader developments within innovation politics at large. In this context, innovation comes to be understood as solution to almost any societal problem (Pfotenhauer and Jasanoff 2017; Braun-Thürmann 2005; Rammert et al. 2016) and is mainly equated with material technology (Godin 2015). Considering the wider context of EU innovation policy, this kind of rationality has not been restricted to the infrastructural milieu of the partnerships discussed in this section. Rather, it has been more or less present during all the previous cases of this chapter, that is, since the introduction of the 5th Framework Programme[63] in 1999. For instance, the rationality of technological innovation forms an important component of how ageing and, more precisely, AHA enters the EU's work programmes. It also runs through the Ambient and Assisted Living Joint Programme, which is, at its core, an "innovation programme" (Busquin et al. 2013, p. 20). Also, the working of this rationality is not surprising since this book's analysis is situated within an apparatus of innovation (see chapter 3.1.). Hence, building on those hints at innovation as decisive factor for interfacing RobotCare, the following section will shed light on how this plays out in practice of innovation policy.

4.4.1. Transforming care: the EIP on 'active and healthy ageing'

Active and Healthy Ageing has not only profoundly impacted the organisation and contents of the EU's work programmes. Rather, AHA materialises as a new kind of actor, a new type of infrastructure, which the European Commission introduced in the course of the 'Innovation Union' initiative in 2010: *European Innovation Partnerships* (EIP). Such partnerships are envisioned to "speed up the development and deployment of the technologies needed to meet the challenges identified" (European Commission 2010a, p. 12). Among the first to be launched was the European Innovation Partnership on 'Active and Healthy Ageing' (EIP on AHA), which started operations in November 2011. This initiative was put forward by the European Commission against the backdrop of an ongoing economic depression and increasing global competition within its "Europe 2020 Flagship" (European Commission 2010b). Here, technological innovation is positioned as "our best means of successfully tackling major societal challenges" (European Commission 2010b, p. 2). As challenges like ageing become

[63] As previously described the 5th Framework Programme has profoundly changed the EU funding policy confronting research and development with the expectation to solve real-world problems and in thus benefit European economic development (see sub-section 4.2.1.).

more urgent "by the day" (European Commission 2010b, p. 2) the development and commercialisation of technology is seen as of paramount political importance.

As innovation is placed "at the heart of the Europe 2020 strategy" (European Commission 2010b, p. 2) this also changes the way namely elderly care features on the political agenda. In the context of the EIP on AHA an unprecedented urgency is attached to *transforming* European care systems.

> "New approaches are needed urgently. Innovation – in all its forms – should play a key role in *rethinking and changing the way we design and organise our society and environment* and organise, finance, and deliver health and social care services, as well as the *whole environment older people are living in*." (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 4, my emphasis)

The major objective of this transformation is to increase the average number of healthy life years of European citizens by two until the year 2020. According to the partnership's Steering Group, this would constitute a "triple win for Europe" (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 6) bettering the health of, namely, elderly EU citizens, rendering health and social care systems more efficient and sustainable, and increasing the competitiveness of EU industries. This goes to show again how the relationship between innovation and ageing is mostly configured as (economically) productive. Furthermore, this emphasis on *social change* through technological innovation signifies a break with previous considerations of ageing in general and elderly care in particular. As alluded to earlier, ageing used to be mainly considered as an epistemic problem to be treated in biomedical terms (see section 4.2.). By contrast, the EIP on AHA formulates the expectation to fundamentally *transform* the social and health care system by help of ICTs and thus solve societal challenges instead of epistemic problems.

Contextualising this diagnosis shortly takes us back to the health work programmes at the beginning of the 6th Framework Programme (around 2002), i.e. before AHA was introduced to the European innovation policy landscape. There are three main aspects to note here. First, for these work programmes ageing features as only one amongst many health-relevant parameters of the population, next to phenomena like migration, education and mobility (European Commission 2005b, p. 51). Second, the primary goal is "to better *understand* the process of life-long development and healthy ageing" (European Commission 2005b, p. 51, my emphasis) and to study possible bio-medical factors that benefit human development. Hence, old age is understood here as an *epistemic* problem. Third, such knowledge about age-related diseases as well as knowledge about the provision of health care is needed for *evaluating* current health care systems, e.g. analysing the provision of long-term care (European Commission 2005b, p. 52) or forecasting trends of population health by way of a comparative analysis of health outcomes (European Commission 2005b, p. 53). Hence, old age mainly features here as a problem of accumulating statistical data about the health of the elderly population and its care. Consequently, this knowledge should eventually inform elderly and health care services to enhance quality of life. While there are efforts in this work programme to extend the scope of mere research, the proposed means to do this remain confined to the ‘scientific arena’, i.e. organising conferences, setting up a road-map for “ageing research” (European Commission 2005b, p. 55) or transferring knowledge into policy discourses but only to facilitate conditions for “comparative research” (European Commission 2005b, p. 55).

This stands in stark contrast to how elderly care and, incidentally, robotics is taken up within the EIP on AHA. Here, care is not primarily informed by bio-medical knowledge about the ageing population but rather is seen as in need of profound organisational and professional *transformation*. In the following, I will illustrate this by the example of the partnership’s Action Group[64] on ‘Integrated Care’. This action group rests on the assumption that

> “[t]here is a need to *re-design health and social care systems* and this will involve the development of *integrated care models* that are more closely oriented to the needs of patients / users, multidisciplinary, well co-ordinated and accessible, as well as anchored in community and home care settings.” (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 3, my emphasis)

The concept of ‘Integrated Care’ is not an invention by the EIP and signifies a multifaceted discourse that goes beyond the confines of European innovation policy (World Health Organization 2016, pp. 3–5). Generally, Integrated Care promises to coordinate care services in more efficient and beneficial ways across different stages of health care (primary, secondary,

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[64] To give a little bit of context first, the aforementioned partnership’s Steering Group has defined six different action groups in its Strategic Implementation Plans, see European Innovation Partnership on Active and Healthy Ageing 2011a, 2011b. Action groups denote thematic clusters of stakeholders which contribute to the attainment of pre-defined targets, for example to realise ‘integrated care programmes’ by 2015-2020 “in at least 20 regions in 15 Member States”, see European Innovation Partnership on Active and Healthy Ageing 2012b, p. 4. ‘Stakeholders’ denote interested organisations, which submit their projects and initiatives to ‘Calls for Commitment’ by the partnership. In order to become ‘partners’ of the EIP such organisations or ‘coalitions’ of organisations are expected to collaborate and contribute to the work and vision of the EIP Action groups and their activities. Following the Calls for Commitment and based on the input, investment and deliverables by the ‘partners’, the action group then elaborates and releases an ‘Action Plan’ which sets out activities to be implemented within the following three to four years (the first ‘framework’ spans from 2012 to 2015, the second from 2016-2018).

and tertiary[65]) and across different dimensions of care (health, social, and community care[66]). Next to raising the quality of care, one central envisioned outcome is to prevent "avoidable/unnecessary hospitalisation" (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 4). So, also this initiative answers to the ongoing bio-political concern of preventing the 'burden' of demographic change by lowering costs and raising efficiency, equally present in projects of telecare (Oudshoorn 2011) and AAL (Krings and Weinberger 2017).

Despite all these continuities, I argue that there is a remarkable difference especially with regard to the *professional* and *organisational* scope of the endeavour envisioned within the EIP on AHA. For this, Integrated Care is a good example. Rather than simply complementing telecare and AAL, this project attempts to integrate all these concerns into a broad transformative effort. Activities in this regard are, for example, the mapping and implementation of new "Organisational Models" of Integrated Care, "Development, Education and Training" of the care workforce, the integration of "Care Pathways" for chronic diseases, and the development of ICT solutions for "Electronic Care Records … (and) Teleservices" (European Innovation Partnership on Active and Healthy Ageing 2012b, p. 12). It is within the context of this broad range of measures that robotics and other ICTs can interconnect with the concern for transforming care. For instance, MARIO, an FP8 robotics project promises "to better connect older persons to their care providers, community, own social circle and also to their personal interests" (MARIO consortium 2015). Another example alludes to the training of caregivers, which should "support their skills, motivation and willingness to use ICT" (European Innovation Partnership on Active and Healthy Ageing 2012b, p. 13).

Hence, the EIP on AHA sees its mission not primarily as a research endeavour or even as a vehicle to create a marketplace for assistive technologies, such as, the AAL programme. Rather, it positions itself as a means to interconnect care and robotics in order to profoundly transform the organisational and professional model, on which European care systems are built. In this

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[65] These categories refer to established ways of distinguishing different types of care work. Primary care covers the first contact a patient has with the health care system. This involves professionals such as general physicians, nurses or pharmacists, whom people consult because of a wide range of ailments. Patients can then be referred to secondary or tertiary care professionals. While the former mostly involves acute cases such as childbirth or emergencies the latter refers to highly specialised consultative health care providing advanced medical investigation and treatment.

[66] Next to health care, social and community care are more focused on social needs in everyday life. While social care is more institutionalised, for example, in care homes or assisted living facilities, community care denotes a model of care, which rests on informal and voluntary care providers close to the home respectively community of the care receiver. Both of the latter categories provide most of long-term care, for example, for elderly people or those with lifelong disabilities.

context, the format of the ‘partnership’ is understood as a collective endeavour towards redesigning care by way of technological innovation. This makes it all the more urgent to partner whole fields in order to “speed up the development and deployment of the technologies needed to meet the challenges identified” (European Commission 2010a, p. 12). In light of this, the partnership stages itself as marking

> “… the first time that such a broad range of stakeholders – from health and social care sectors as well as business and civil society – have agreed on a shared vision and a comprehensive framework for action.” (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 4)

Hence, health and elderly care are not merely seen as testing grounds for research or as a designated market (such as in the previous two sections) but also as objects (and subjects) for *transformative* action. The EIP is not primarily interested in understanding biomedical processes of ageing but rather in partnering care as an actor of innovation in the quest to redesign society around the vision of “active ageing and independent living for older people” (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 10).

This brings me to the second aspect of the rationality of technological innovation, i.e. its imperative to *partner,* i.e. to enrol and coordinate an extensive range of communities and actors. While this aspect applies to the EIP, I will illustrate this point in more detail with regard to another partnership, the public-private ‘Partnership for Robotics in Europe’ (SPARC). Here, robotics itself is problematised as a collection of ‘fragmented communities’ in need of ‘defragmentation’, i.e. partnering.

4.4.2. Partnering robotics: the public-private ‘partnership for robotics in Europe’

Only two years after the establishment of the EIP on AHA, the ‘Partnership for Robotics in Europe’ (SPARC) is founded in December 2013. It marks the preliminary result of a series of coordinated efforts between the European Commission and the robotics research and industry communities. In the following, I will trace the genealogy of how a “European strategy for robotics” (Partnership for Robotics in Europe 2013, p. 4) has been interfaced in the past two decades.

The project of a common strategy for robotics in Europe started in the early 2000s when the ‘European Robotics Research Network’ (EURON) and the ‘European Robotics Technology Platform’ (EUROP), at that time institutionally separated, began formulating their respective visions of European robotics in research agendas and roadmaps[67] (European Robotics Technology Platform 2009; European Robotics Research Network 2004; European Robotics Technology Platform 2006). These two infrastructures were already results of an ongoing process of Europe-wide coordination[68] between the European Commission and actors considered part of the robotics research (EURON) and industry community (EUROP). Hence, the bare fact that this discourse is able to speak about a European 'academic' resp. 'industrial' robotics community rests on this first wave of infrastructural activity.

In the late 2000s and early 2010s, these first endeavours culminate in a second wave of infrastructural activity on the European level whose products were a unified European robotics association (euRobotics) and the aforementioned public-private partnership SPARC. These new infrastructures were aimed "to overcome the *fragmentation*[69] between and within sectors and the different communities" (Bischoff et al. 2010, p. 729, my emphasis). According to an euRobotics official, this fragmentation mainly alluded to the two former associations, one for the academic branch called EURON and the industrial technology platform called EUROP, which have since their inception constituted robotics as divided into two "separate worlds" (Interview euRobotics, 13/04/16). The aims is precisely to exploit and commercialise robotics technology, which is seen as hampered by that separation (Bischoff et al. 2010, p. 729).

[67] Both, EURON and EUROP, were supported by funding under the 'Future and Emerging Technologies' objective of the 'Information Society Technologies' Work Programme which aims at 'nursing' new emerging fields of research and technology development, see European Robotics Research Network 2002; European Commission 2015d. On one hand, EURON formed in the beginning of the 2000s and was mainly concerned with stimulating research and development in new fields of service and industrial robotics, for example, by publishing a white paper in 2001, see Christensen et al. 2001, and later the 'EURON Research Roadmaps', see European Robotics Research Network 2004. EUROP, on other hand, formed later in the mid-2000s as an industry-driven forum for coordinating research and development towards certain applications and markets. This is exemplified by two Strategic Research Agendas published in the course of the 2000s, see European Robotics Technology Platform 2006, 2009, which were both funded by CSAs. The status of EUROP as a 'Technology Platform' also illustrates its closeness to European innovation politics since it denotes another specific format introduced by the European Commission to better coordinate and represent certain technology areas on the European level.

[68] This notion of 'coordination' is repeatedly put forward in EU innovation policy discourse. Concretely, it refers to a particular format of strategic funding on the part of the European Commission called 'Coordination and Support Actions' (CSA). Funding of a CSA is not aimed at "research itself, but the *coordination* and *networking* of projects, programmes and policies", see European Commission 2007a, p. 21. Targets or products of such efforts can be 'Strategic Research Agendas', roadmaps or partnerships.

[69] Fragmentation has already been a concern in the research agendas and roadmaps of the first wave of infrastructural activity. What distinguishes first and second wave are the kinds of measures taken and the targets they aim at. While EURON and EUROP have positioned themselves as solutions to the problem of fragmentation, one for academia, one for industry, SPARC and euRobotics problematise precisely those two networks as showing the community's fragmentation.

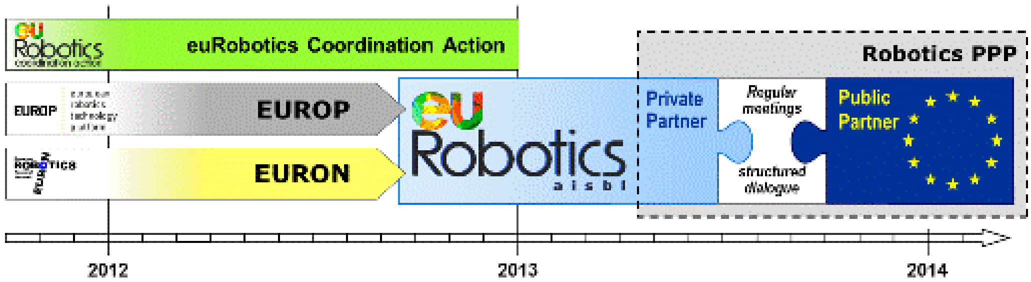

Figure 9 SPARC timeline (euRobotics 2018a)

As a first countermeasure, two consecutive Coordination and Support Actions (CSAs) aimed at re-organising those ‘fragmented communities’ of robotics from 2010 until 2012 (see figure 9). The first coordination action called ‘CARE’ was mainly directed at coordinating robotics related R&D activities during the first three years of the 7th Framework Programme[70], that is, providing research priorities and agendas for its work programmes. The second CSA called ‘RockEU’ was explicitly aimed at laying the foundations for a united “association for all stakeholders in European robotics” (euRobotics 2018a). This culminated in the foundation of the ‘euRobotics AISBL’[71] in Brussels on 17 September 2012. On one hand, this new association reproduces the distinction between industry and research (e.g. in its board of directors and its general assembly, see figure 9). On other hand, it integrates them within one single organisational milieu aimed “to boost European robotics research, development and innovation” (euRobotics 2018a).

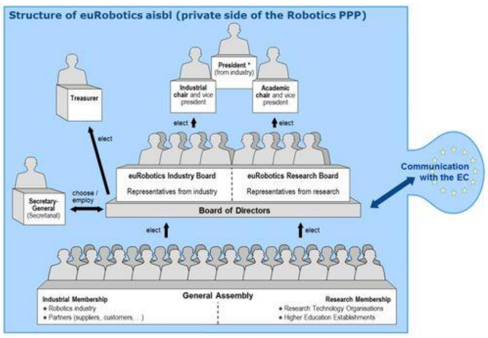

Figure 10 euRobotics's governance structure (euRobotics 2018a)

The motivation for founding euRobotics was not only oriented ‘inward’, interfacing the European robotics community, but also ‘outward’, interfacing the robotics community with the funding regime of European innovation policy. As figure 10 shows, the job of the euRobotics

[70] It is also within this timeframe of the 7th Framework Programme that robotics consolidates as a distinct funding topic in the first place. Before that, funding into robotics-related topics was mainly subsumed under Artificial Intelligence (AI) and robotics featured merely as one possible application area of AI amongst others.

[71] ‘AISBL’ indicates that euRobotics is an ‘association without lucrative purpose’. The abbreviation stems from the French term ‘association sans but lucratif’.

AISBL is to maintain communication with the European Commission within a public-private partnership. Hence, the second CSA's rationale was to establish euRobotics as the future private side of the public-private partnership SPARC with the European Commission. Only two months after euRobotics's establishment, SPARC was founded on 17 December 2012 by way of a contractual agreement between the European Commission and the European robotics association. The partnership comprises around €700M of public investment into robotics R&D under the Horizon 2020 Framework Programme. This amount is hoped to attract up to four times as much in additional private investment. The European Commission's Vice-President at the time Neelie Kroes legitimises this commitment on the part of the European Commission by stating that "[a] strong robotics industry is key to Europe's future competitiveness" (European Robotics Association 2012). Thus, SPARC denotes a (maybe preliminary) climax in the gradual discursive but also material genesis of robotics on the agenda of European innovation policy.

This short genealogy of "European strategy for robotics" (Partnership for Robotics in Europe 2013, p. 4) shows how a 'European robotics community' has gradually been infrastructured through a long series of coordinative activities, such as CSAs and a public-private partnership. While this has rendered visible the discursive milieu of robotics and the way it has been interfaced through re-organising 'its' institutions on the European level, it still goes to show through what processes SPARC aims to render academia, industry and the European Commission available for one another via the rationality of technological innovation. An example for such a practice of interfacing are so-called 'topic groups'. Topic groups are opened by euRobotics's members and are coordinated by its 'Board of Directors', a body of representatives equally representing research and industry. They are an instrument by the association to provide a content base for SPARC's 'Strategic Research Agenda' (SRA) and its companion document the 'Multi-Annual Roadmap' (MAR)[72]. 'Relevant' topics can range from particular domains, such as 'Industrial Robotics' or 'Robot Companions for Assisted Living', to 'non-technical' topics, such as 'Ethical, Legal and Socio-Economic Issues' (euRobotics 2018b).

[72] While the SRA functions as a "high level strategic overview", see euRobotics 2018b, namely aimed at policy makers, investors or entrepreneurs, the MAR provides a "more detailed technical guide", see euRobotics 2018b. The latter also sets respectively recommends R&D&I priorities to the European Commission which it then can implement into its work programmes. This, again, is an example of how discursive infrastructures such as partnerships interconnect with other infrastructures such as the EC's work programmes. It also shows how the effects of SPARC are similar to the EIP on AHA since the latter also had a coordinative effect on the ICT and health work programmes (see section 4.2.).

> “[Topic groups] identify gaps and challenges, describe the desired paths towards solutions, milestones to be reached at specified instants in time and with a specified quality. They identify Innovation Milestones, and mobilise members and non-members to realise them, and to support their subsequent exploitation. Activities span the full spectrum from basic research, to technological development, and concrete innovation, showing smooth paths of knowledge transfer along the covered spectrum, and identifying concrete actual and potential academia-industry cooperation.” (euRobotics 2018b)

Hence, topic groups mobilise members and non-members around particular ‘gaps’ and ‘challenges’ ultimately with regard to ‘Innovation Milestones’ and their ‘exploitation’ while still incorporating basic research in order to attain them. Here, an interesting tension arises between the overall political architecture of euRobotics and the concern of innovation. While, on one hand, euRobotics equally represents academia as well as industry and while its activities cover ‘basic research’ and ‘concrete innovation’, it, on other hand, sets innovation as its primary objective “strengthening competitiveness and ensuring industrial leadership” (euRobotics 2018a). In an interview, an euRobotics official expresses this via a rather militant metaphor saying that the cooperation between academia and industry must follow “the right route of march” (Interview euRobotics, 13/04/16). This is to say that the interfacing of robotics in the context of a European association and partnership makes a difference with regard to the general orientation of robotics (research). It does not leave robotics unaltered but rather seeks to *reconfigure* it according to a particular rationality and, incidentally, according to an industrial drive within this ostensibly ‘united’ community[73].

This aspect of euRobotics and, incidentally, SPARC also becomes visible in an interview with the innovation manager of a German robotics company (Interview Robotics Company[74], 03/05/16). For him, the most important concern is to create “disruptive innovations” (ibid.). He problematises deficits of scientists to collaborate across disciplinary boundaries. In his view from the position of an innovation manager, this is problematic, since one discipline may already have ‘the’ solution to a particular problem, while other disciplines do not know about it. He proposes that “[s]uch inefficiencies can be overcome” (ibid.) via interdisciplinary topic

[73] Looking at the formation of robotics seen from this angle, one can argue that industrial actors have been particularly active in this process. Here, especially EUROP, the industry-led robotics platform, along with major players in the European robotics market, especially the German company KUKA, have pushed towards coordinating robotics within a singular association. For example, EUROP initiated the first coordination action CARE coordinated by KUKA, see Community Research and Development Information Service 2013, and coordinated the second coordination action RockEU, see Community Research and Development Information Service 2017.

[74] Unfortunately, the transcript of this interview was lost due to a problem with my recorder. Hence, in the following, I rely on my reconstruction of the interview recorded via field notes.

groups. However, in practice people often propose separate topic groups in, from his perspective, identical areas. So, instead of transcending disciplinary and 'merely' "theoretical differences" (ibid.) scientist roboticists are deliberately pushing their own projects and, thus, their own 'partial' perspective. In such cases, the 'board of directors' intervenes and does not approve of such topic groups. Hence, from the innovation manager's point of view 'theoretical differences' do not matter but create inefficiencies with regard to the goal to achieve 'disruptive innovation'. In this regard, topic groups interface disparate research communities by disciplining their 'differences' with regard to the attainment of 'Innovation milestones'.

Technological innovation affords a smooth translation of robotics technology from academia to its prospective industries. This creates the urgency to extensively align robotics under one 'European strategy'. Here, the infrastructural milieu of euRobotics has gradually installed a discourse, which is not only able to speak *about* but *for* the European robotics community. It is through the interfacing of formerly 'fragmented' communities that robotics can become an addressee and addresser for Europe's "competitiveness" (euRobotics 2018a) and "major societal challenges" (European Commission 2010b, p. 2). This signifies the process by which robotics could take shape within European innovation policy as an agent of technological innovation.

4.4.3. Interfacing care and robotics as agents of innovation

In this section, I have shown how the rationality of technological innovation comprises two components. Firstly, it applies a transformative register to funding research and technology development. While I have shown the transformative aspect of innovation for the EIP on AHA, this also applies to SPARC which propagates that "[r]obotics has the potential to *transform* lives and work practices" (Partnership for Robotics in Europe 2013, p. 3, my emphasis). This does not mean that robotics simply is the driver of change but rather also its target. I have illustrated this with regard to an unprecedented urgency that is attached to the interfacing of a 'European robotics strategy', where robotics research is confronted with an industrial agenda to strengthen European 'competitiveness' and integrate across disciplines. Secondly, the rationality of technological innovation demands for both domains to partner within two specific infrastructures, the EIP on AHA and SPARC. Especially SPARC rests on manifold, long-lasting processes of interfacing formerly 'fragmented' research communities and industries within aligned formats of collaboration oriented towards the attainment of innovation.

It is important to stress the *productive* effect of such interfacing processes. Robotics and elderly care do not simply enter European innovation policy, they are gradually *produced* through manifold efforts to partner (for example, in ‘action groups’ or ‘topic groups’) as addressable actors of the political mandate to solve ‘grand societal challenges’. What this discourse of European innovation policy presupposes as ‘robotics’ and ‘care’ really is the *product* of a long series of interfacing practices. These practices denote infrastructural efforts to create partnerships as agents of technological innovation.

4.5. Infrastructural mode of interfacing

The starting point of this chapter was my enquiry into how robotics and elderly care could emerge and become interconnected as mutually compatible topics within European innovation policy since the new millennium. Departing from this puzzle, I have argued that both domains and their mutual interconnection have become utterable and desirable through infrastructuring particular rationalities of interconnection. In my analysis, I have identified three of such rationalities and investigated them within three respective infrastructures: active and healthy ageing within the EU’s health and ICT work programmes, ambient assistance within the Joint Programme on Ambient Assisted Living, and technological innovation within European innovation and public-private partnerships related to robotics and care.

In the first case, I have shown how active and healthy ageing has reshaped the infrastructural milieu of EU work programmes by aligning especially health and ICT related funding. This has installed the conditions for ICT development and concerns of care to interconnect, i.a. social robotics and elderly care. While the FP5 and FP6 did practically not feature either of the two topics, the FP7 positioned the interconnection of service respectively social robotics and elderly care as central to the attainment of ‘ageing well’. On one hand, this has elicited social aspects of robot development, where the emphasis lies on users’ acceptance and empathetic modalities of human-robot interaction. This is predominantly seen as technical challenge of a new kind of robotics paradigm, for which elderly care functions as a testbed. On other hand, these work programmes put an unprecedented focus on the daily living and social care of the elderly as well as on assistive technologies to support them. Here, social robots are expected to demonstrate increased quality and efficiency of care as well as higher independence for elderly people living at home. This has effected a shift respectively an expansion regarding the disciplinary spectrum away from biomedicine towards the technical sciences. In this context, social robots could crystallise as promissory proxies for tackling demographic change with assistive ICTs.

In the second case, I have shown how in the context of the AAL programme ambient assistance has operated as another rationality of interconnection re-appropriating two formerly disparate discourses on Independent Living and assistive robotics. Both of these discourses problematise institutionalised forms of care arrangements albeit out of different concerns. On one hand, the disability movement positions *personal* assistance as a vehicle to criticise 'paternalistic' forms of care and to empower the elderly to choose the kinds of assistive services and technologies they need in order to live independently. On other hand, assistive robotics reconfigures care as a testbed for human-robot interaction, where it can test robots' performance by way of a more or less recurrent portfolio of engineerable tasks. Essential for the interfacing of robotics and care is that AAL *selectively* re-appropriates and interconnects those existing discursive threads. Here, the rationality of ambient assistance renders robotic devices available for dissectible assistive tasks in the elderly's living environment. Within networked, highly technologised care arrangements, assistive robotics is seen as realising the target value of allowing elderly people to live more independently at home for longer (while relieving institutionalised care of 'unnecessary hospitalisation'). It is this interfacing of Independent Living and assistive robotics, which underlies the mission to create a European market for robots in the elderly's home.

Finally, I have shown how technological innovation operates as a third rationality of interconnection. Here, both domains, robotics and care, have been confronted with the imperative to orient themselves towards attaining technological innovation and, in order to do that, coordinate within Europe-wide partnerships. The first aspect of this rationality relates to how the disciplinary landscape within EU work programmes has effectively shifted with regard to health and ageing from biomedical to technical sciences. While the former has traditionally viewed ageing as an *epistemic* problem, innovation partnerships effect a *transformative* logic of research and development aimed at *re-designing* and *re-organising* care systems by way of information and communication technology (ICT). The second aspect, the imperative to coordinate within partnerships, shows how in order to attain those goals care and robotics need to become addressable actors of and agents in European-wide innovation processes. This requires manifold interfacing processes aimed at partnering formerly 'fragmented' communities around 'shared' research visions and frameworks of action. The case of SPARC shows here that this requires scientific conflicts to be reconciled in favour of the goal to attain innovation. This means that involved (scientific) actors need to be disciplined *vis-à-vis* a business-oriented logic of bringing technology to the market. It is the interfacing of formerly disparate communities within innovation partnerships that has produced 'care' and 'robotics' as addressable and, consequently, interconnectable agents of European innovation policy.

Analysing these different rationalities and infrastructures shows the immense ubiquity but also multiplicity of discursive practices that have helped establish an interconnection, which was practically not talked about at the turn of the millennium. So, while I have analysed these manifold practices with regard to the phenomenon of RobotCare they are by far not exclusively targeted at realising the specific vision of robots caring for the elderly. For instance, the shift in funding policy effected by the 5th Framework Programme was not a conscious preparation of RobotCare nor was this vision its only 'offspring'. One can observe similar narratives with regard to other projects such as telecare (Oudshoorn 2011; Pols 2012) or ambient and assisted living (Neven 2015). Hence, the rationalities of interconnection discussed in this chapter are not entirely specific to RobotCare *per se* but rather indicative of a more general *infrastructural mode of interfacing*.

Here, interfacing is effectively targeted at and confronted with grand political challenges, which are massive in scale and while their repercussions are already detectable in the present they only take full effect in a relatively distant future (Kaldewey 2013). For instance, demographic change is usually depicted as a matter of decades before it realises itself and its negative consequences become 'inevitable'. Correspondingly, RobotCare does not feature as a present reality in this context but rather as a future opportunity, which upon realisation could eventually solve that challenge. Re-orienting funding programmes, creating a marketplace for AAL or funding innovation partnerships attains plausibility as a response to those opportunities, since these activities install infrastructural milieus, in which such opportunities are believed to become attainable. Here, this attainability seems to be directly coupled with enabling ever more extensive and intimate interconnections between technology and society, robotics and care. In this context, elderly care cannot be prepared by simply increasing its budget or by knowing more about age-related diseases. Rather, it needs to be interconnected with innovative, emerging technologies, e.g. robots, it needs to be unified around a vision for integrated care systems, and it needs to be re-interpreted as assistive service. In turn, robotics cannot stall at doing basic research but needs to demonstrate its viability (and thus fundability) with regard to its effects on the efficiency and quality of care. It too needs to re-organise itself *vis-à-vis* a vision of active and healthy ageing as well as the expectation that robotics will bring jobs and growth to the European economy.

Hence, interfacing is oriented towards installing the conditions for future interconnections to at least begin to take shape now. In other words, such interfacings aim to infrastructure the 'not-yet'. Applying robots to elderly care is thus configured in terms of an anticipatory preparation *vis-à-vis* the challenge of demographic change. RobotCare within this mode betokens a particular *model* for the future. It is in this sense that practices of interfacing can be infrastructural: they reshape the present in order to realise an imaginary future (Larkin 2013, p. 332). Active and healthy ageing, ambient assistance, as well as technological innovation have rendered RobotCare have managed to attach an unprecedented desirability to this project – irrespective of its benefits and prospects in actual practice.

5. Prototyping RobotCare

Based on this genealogy of RobotCare, my analysis now shifts to another context, an EU funded robotics R&D project "for the ageing population" (project website). This project remains highly connected to innovation policy but is characterised by a different kind of imperative, namely, to *materially prototype* RobotCare and demonstrate its future potential "in realistic tests within fictitious scenarios" (experimental protocol, p. 67). This robotics project denotes yet another milieu where RobotCare is interfaced or, to be more precise, where roboticists and other project participants *prototypically interface* robots, people, and care-like environments. Here, the prototypical alludes to the double task of, on one hand, making integrated robot systems 'work' with elderly users in realistic environments and, on other hand, demonstrating that robots are 'viable' and 'plausible' solutions to elderly care problems. In order to achieve this, robots need to prove themselves in the course of Human-Robot Interaction (HRI) experiments with (elderly) users in a testbed environment supposed to emulate realistic conditions of elderly care.

For investigating these phenomena, the following chapter is divided into four sections. First of all, I begin by introducing my research object, a European robotics project, the empirical entry point as well as the heuristic approach of this case study. Here, I will tease out how an analytics of interfacing draws theoretical resources from STS to study HRI experiments (5.1.). Secondly, I will show how interconnections between robots, people and care-like environments are highly fragile and in constant need of interfacing a robot-friendly milieu. 'Caring', thus, does not so much relate to robots assisting human beings. Rather, roboticists and others *care for robots* in order to make them work under messy circumstances (5.2.). Third, since materially interfacing robotics and elderly care remains highly constrained and fragile, roboticists temporarily *stage robots for care*. The purpose of such theatrical staging practices is to stimulate users to imagine but also enact 'plausible' interconnections between their supposed needs and assistive robots (5.3.). Fourth, in summarising my findings I will argue that these HRI experiments do not simply produce a prototypical technology, a care robot, but they materialise a prototypical mode of interfacing, through which possible (future) interconnections between robotics and elderly care are probed and explored (5.4.).

5.1. HRI experiments 'in the making'

The research object of this chapter is a European R&D robotics project, which aims to develop, test, and implement assistive robots for elderly people. It is embedded within the 7th Framework Programme and thus tightly connected to the previously analysed context of European innovation policy discourse. The investigation of this project draws mainly on two consecutive field trips, where I gathered ethnographic material (field notes and video data). During this time, I have become an active part of this project. This serves as the background for positioning my approach to phenomena of HRI experiments, which is rooted in laboratory studies but which takes a special interest in two kinds of interfacing practices: caring for and staging robot technology.

5.1.1. A European robotics project 'for an ageing society'

The project[75] analysed in the following sections was funded by the EU during the 7th Framework Programme. The project ran from 2012 until 2015. In total, the consortium consists of about a dozen institutions, both research organisations and companies, from four different European countries. Most partners came from a Southern European and a Central European member state of the EU. The coordinator of the project was located in the former. The remaining countries of origin were located in the North resp. Northwest part of the European Union.

The project heavily invests itself in and, thus, remains tightly linked to the discourses on RobotCare outlined and analysed in chapter 4. Here, the project answers to the call for robotic "solutions … for improved independent living and quality of life of elderly people and efficiency of care" (European Commission 2011, pp. 71–72). In turn, it positions itself as a vehicle to ultimately "demonstrate the general feasibility, scientific/technical effectiveness and social/legal plausibility and acceptability" (Project brochure, p. 2) of such robotic solutions. Hence, the project is expected to go beyond merely conducting basic research (European Commission 2011, p. 72) and rather develop an integrated robot system fit for interaction with users in "unstructured[76] environments" (Project presentation, p. 3). The task of testing robots 'in care' with 'real users' has then two consequences for how the project operates.

Firstly, it means that the disciplinary scope of the project stretches beyond the usual suspects such as engineering, computer science or HRI. For example, the consortium featured a public institute from Southern Europe specialised in gerontology as well as geriatrics charged with the task of "guaranteeing the link between real needs of older people and developed technologies" (Project website). Furthermore, the project involved a Central European consulting firm

[75] The project's name, its participants (institutions and people) as well as the places in which it took place will be anonymised and, if necessary, replaced by made up names.

[76] 'Unstructured' here alludes to roboticists' vocabulary of talking about the messiness in non-industrial, everyday settings where robots are exposed to a number of unpredictable events and circumstances, such as human behaviour. It does of course not mean that, from a socio-material standpoint, these settings are unstructured, as I will show in the course of this chapter.

specialised in user experience (UX) and user-centred design, which brought in psychological and sociological expertise for assessing and evaluating the experiments.

Secondly, this meant that the robots have to be probed not only in robotics laboratories but also in two testbeds, one in Southern the other in Northern Europe. My analysis of the experiments is restricted to the latter facility and to the so-called 'second experimental loop' of the project. This loop contained a series of experiments and tests at the end of the overall time frame of the project in June and August 2015. Their main objective was to finally integrate the robots (during pre-tests in June) and subject them and the services they should perform to a final evaluation by elderly users (during the realistic experiments in August). During my field trips those experiments were conducted in a "test apartment" (Innovation network website) specifically installed and furnished for testing assistive technologies for elderly care and with elderly users. The apartment was designed to emulate the conditions of an assisted living home and was located within an actual care facility. This was taken as indicative of the 'realism' of the HRI experiments, an important vehicle for a new paradigm of robotics that posits to 'move out of the shop-floor', as described in the previous chapter.

5.1.2. Practices of caring and staging in HRI experiments

The case study of this chapter investigates HRI experiments by way of ethnographic observation, which is supported by video data. In doing so, the present study builds on the tradition of laboratory studies in STS (Knorr-Cetina 2001; Latour and Woolgar 1979; Knorr-Cetina 1999; Knorr-Cetina 1981) and, more specifically, on research that has applied this approach to the field of (social) robotics (Alač 2009; Alač et al. 2011; Bischof 2017; Šabanović 2007). Similar to the 'first wave' of laboratory studies in the 1980s and 1990s, the present study investigates robotics as "science in the making" (Latour 1987, p. 4), i.e. the mundane and everyday practices of roboticists when they engage in 'doing HRI experiments.' This approach productively complicates taken for granted assumptions since its "interest in the details of scientific activity cuts across the distinction between 'social' and 'technical' factors" (Latour and Woolgar 1986, p. 27). For the following case study, this means that I am not merely interested in the social factors of HRI but rather in the material-discursive practices that enable phenomena of HRI to emerge (or not). This, for example, includes the way roboticists prepare and re-arrange the setting of HRI experiments, which methodically meant to set up cameras not only in the spaces where the interaction between robots and users took place but also in the so-called 'control room' where roboticists would control and oversee the experiments. While this research interest has caused some bewilderment among project members[77], they rather quickly got used to my presence. This was also due to the fact that the UX company through which I got access to the project charged me with the task of coding the experiments during the actual tests in August. I was not perceived as an external observer throughout my field study but as an active participant of the project.

Most of laboratory studies chose the scientific laboratory as their empirical entry point. While some scholarship on the case of social robotics follows in the footsteps of these early ethnographical accounts (Bischof 2017), others have pointed to the fact that since robots are expected to prove themselves under 'real world' conditions the very nature of experimental settings changes (Šabanović et al. 2006). Alač (2011), for example, shows the management activities by roboticists of staging and enacting relations of their robots with users, in her case, toddlers in a preschool, stressing the importance of the latter's contribution to the sociality of social robots. Contra Latour she argues that roboticists cannot simply 'extend' their laboratory conditions into the preschool but rather have to practically and socially deal with the organisational and social peculiarities of the latter milieu (Alač et al. 2011, pp. 917–920). The field site of the present study, the test apartment, evades a clear categorisation into either of the two categories. It is neither a full-fledged robotics lab nor does it denote a real-world setting, since no elderly person actually lives in the apartment. In other words, it could rather be categorised as a test bed or living lab (Liedtke et al. 2012; Hakkarainen 2017; Schulz-Schaeffer, Meister 12/4/2015), i.e. an experimental space where nascent technologies are piloted in more or less realistic environments often with users as test subjects or even as co-creative partners in the development process. On one hand however, elderly users were simply summoned for evaluating the final designs, at least in the encounters that I could observe. On other hand, conducting tests in the test apartment meant to expose the robot system to new complexities, which could not all be anticipated by roboticists. Hence to a certain extent, the test apartment takes an in-between position when it comes to the social worlds of the robotics lab and the care home. That is why this milieu denotes an excellent site for studying the way project participants work to interface care and robotics.

[77] For example, in some instances I discovered that participants would at times approach the cameras and inspect them. One of the computer scientists even switched the cameras off and, after a certain time, back on again. Also, they often joked about how they were watched and checked on by 'Big Brother'. Finally, there were, albeit few, participants who questioned whether my camera setup should be allowed at all be it for reasons of disclosing otherwise 'hidden' epistemic or personal information. While the former concerns stopped quickly the latter was met with an appropriate consent form signed by all participants and a non-disclosure form signed by myself.

This is also where my focus on *prototypical* interfacing practices and their specific milieu comes in. Since neither robots nor their application in elderly care are already accomplished, I am interested in how roboticists in particular and European innovation politics in general aims to *prototypically* render elderly care and robotics available for one another. This also means that I am not strictly interested in 'HRI' as such, that is, in the interaction between robots and people. I am rather following an analytics of interfacing in the sense that I am interested in the material-discursive practices that enable interconnections between robots and people to arise in the first place. Again, I am not primarily interested in relations but in the processes of bringing-into-relation.

In order to orient the following analysis, I will stick to a twofold heuristic, which means that I will trace two particular kinds of interfacing practices: *caring* and *staging*. Both of these sets of practices have been theorised and adapted to the (ethnographic) study of technology (Puig de la Bellacasa 2011; Möllers 2016).

In the case of *caring*, Puig de la Bellacasa has laid out a way for (feminist) STS analysis to go beyond viewing technology (and science) as matters of concern (Latour 2004b, 2004a) but rather as "matters of care" (Puig de la Bellacasa 2011, 2017). 'Care' here serves as an analytical trope to capture the otherwise neglected circumstances of techno-scientific practices and to counteract tendencies of their overarching regimes to conceal the herein entailed "petty doing of things" (Puig de la Bellacasa 2011, p. 92; see also Suchman 2007, pp. 217–220). In the case of the present study this alludes to the way social robots are presented, for example within innovation discourse, as autonomous beings that are able to fully adapt to people's needs "and not the other way around" (Heeren 2013, p. 5). Counter to this, I will show the manifold instances and concrete practices, in which roboticists need to engage in order to adapt the care-like environments and elderly users to the robot's needs[78] (see section 5.2.). Interfacing in this context means to prototypically reconfigure a wide range of elements *vis-à-vis* each other in order to render the test apartment's milieu 'robot-friendly'.

The other heuristic trope, through which I will analyse roboticists' practices is the one of *staging*. Technoscience has a longstanding tradition in not only constructing new kinds of technical objects but also in staging technology and (political) claims about it in front of

[78] This argument is not entirely new but, as discussed in chapter 2, has been pursued by Pols 2012, pp. 34–37. Here, she argues that telecare devices can operate as mediators of patients' care for nurses (e.g. making sure to not call them when they are busy) or as objects of care by patients (e.g. calling it a friend). Such "mutual care" relations This has even been experimentally explored as a way to enhance usability of care robots, see Lammer et al. 2014.

audiences outside science (Shapin 1988, 2008). More recently, Möllers (2016) has made an intriguing contribution to this literature by arguing that engineers in developing new technologies rarely manage to articulate the interconnections they promise. This means they have to temporarily stage these interconnections in, what Möllers (Möllers 2016, p. 353) calls "technoscientific dramas". Drawing on Goffman's interactionist framework (Goffman 1956, 2013) she analyses the manifold theatrical practices, through which engineers stage the plausibility and viability of their technology. While Möllers' study draws on the specific case of surveillance technology and how it is staged in specially organised events for funders, I will take the trope of the technoscientific drama as a heuristic avenue to describe how roboticists stage robots within HRI experiments (see section 5.3.). Staging, I argue, is central to the epistemic practice of assistive robotics. Interfacing in this context means to narratively embed both users and robots within "fictitious scenarios" (experimental protocol, p. 67) while at the same time invisibilising the messy circumstances, in which such scenarios are supposed to be realised.

5.2. Caring for robots

In the following, I will analyse the manifold activities, through which roboticists aim to make their machines work with users in the test apartment. Here, 'working' does not simply refer to computational processes 'inside' the robot but rather to the establishment and maintenance of more or less stable interconnections between the robot system, users, and spatial surroundings. To achieve this proves to be extremely difficult in practice. In these experiments, interactions between robot systems and test subjects frequently fail and break down. Thus, 'caring' does not allude to the robot's capability of assisting the elderly but rather to people's efforts installing the conditions of HRI experiments in such a way that they are supportive of the robot's operation. The following analysis takes HRI experiments as "matters of care" (Puig de la Bellacasa 2011), thus, shedding light on the vast range of usually invisible, techno-material elements of HRI experiments that need to be carefully (re)arranged for it to work.

This analysis' empirical entry point are the so-called pre-tests, which I attended during my field trip in June 2015. Here, the primary focus of project members was on 'integrating' the robot system and on conducting first tests with non-elderly users[79]. As a way to show the procedural character of how the tests are prepared and conducted, the following empirical examples will

[79] Project members consciously recruited younger test subjects for the pre-tests in order to spare the robot system the complexities and pitfalls of interacting with supposedly frail elderly people. This, too, signifies a particular interfacing practice of caring for the robot, which I will focus on in section 5.2.3.

be organised according to typical phases that experiments go through and to the different elements that are involved in them, e.g. configuring the robotic system for the experiments, recruiting test subjects and the experiments themselves.

5.2.1. Precarious demonstrations: integrating robot(ic)s

There is no such thing as a robot. There is no such thing as robotics. Instead, robots denote integrated systems that consist of components developed by research teams, which belong to divergent disciplines. These mostly are computer science, engineering, informatics, computer vision etc. Consequently, to build such an integrated system is not the primary epistemic interest of these disciplines and teams. The robot system usually is merely denotes a residual product of 'robotics' projects, which serves as a demonstrative milieu, in which each partner can tests their components' functioning (Meister 2011). However, in the case of this project, the funder, i.e. the European Commission, expects the demonstration of an *integrated* system. The project cannot merely construct "basic robotic components" (European Commission 2011, p. 72) but must rather probe a robot system in care-like environments with elderly people. These contradictory logics set in motion precarious demonstrations, where integrating robots means to laboriously interface a range of different technologies and people during a localised 'integration week'. Here, project members are forced to improvise and tinker around with robots as spatially distributed systems as a way to prepare them for 'pre-tests' with users.

A thousand pieces

Field note (08/06/15)

Before my first day at the test apartment, project members from the local university have already worked for about a week to integrate the robot system. The first pre-test is scheduled for the morning I arrive. The test facility, a compound of rooms designed to look like an assisted living apartment for the elderly, buzzes with activity. About ten people run around, type on their laptops, give each other advice, and discuss what still needs to be done. The apartment abounds with a myriad of cables, robots, screens, keyboards, mice and other equipment. This differs greatly from the online pictures I have seen of this apartment on the facility's website. The pictures there feature happy-looking elderly people in a tidy, comfortable home. Now, so it seems, roboticists and their machines have settled in here for good.

One of them, Francis, a computer science professor of the local university and my contact person 'on the ground', approaches me and starts to explain. „The robot is a very complex system." It is especially difficult to get all the different parts to run together. Roosje, one of Francis' PhD students seconds that: „About a thousand pieces need to work together there!" Philipp, another one of Francis PhDs describes the resulting work process as follows: „You build your module so that it works in a certain way. You have to predict what the other modules are doing. Basically, it's only the interface that matters, but the modules do not always work as expected." Everybody comes with functioning systems, which do not work anymore, if they have to work together. It is for these unexpected failures that meetings such as these are so important for the research project. „We can have Skype meetings but I prefer these meetings, because everybody is together in one place", Francis says.

These conversations with roboticists give insight into the development process of robots, which turns out to be highly distributed. This means that, at least during most of the project's runtime, there is no such thing as 'the robot'. Rather, what roboticists deal with are their own specialised components ('modules'), which they develop independently from one another. This division of labour is only tied together via the computational 'interface'[80], which defines the way the different hardware and software components should communicate with each other. This is done by standardising the expected outputs respectively inputs of those components. However, Philipp reveals in the conversation above that this is merely an abstraction of what really happens when trying to integrate such a robot system. Components do not simply fit together since they 'do not always work as expected'. 'Integration' does not mean to put together finished elements according to a pre-defined structure (the 'interface') but rather to laboriously render all these elements available for one another. This, according to Francis, is only possible *in situ* during specially organised events such as the 'integration week'. Here, the different teams work closely together in a local environment and directly with the material robot platform. The need for this becomes clear during the following week when people from different teams come and go. Malfunction was often attributed to the absence of people that, during their stay, had changed something in their component messing up its communication with the 'thousand pieces' of the system.

Judging from my field observations, integrating robots is not a formulaic routine task but rather highly improvised. This improvisation seems to be essential not least because, on this morning, a lot does not work as expected.

Something is terribly wrong

Field note (08/06/15)

Most of the action takes place in and between control room as well as living room. In the latter the robot remains immobile. I have not yet seen it in action. Philipp, a master's student and part of Francis's lab team, hastily runs back and forth between the two rooms, tampering with the robot platform or typing something at the main terminal in the control room. I position myself

[80] When put into quotation marks I do not mean my conceptual account of the interface respectively interfacing but rather the field notion of a computational infrastructure as described by the computer science professor Francis.

right between the two rooms in the hallway. Opposite to me, Francis leans casually against the wardrobe. He starts talking to me. "This is typical. If you try to demonstrate, you have hardware problems." He explains that the system does not recognise the laser sensors or that they do not respond to the system. (…) A "low level software" connection problem, he explains further. The lasers supply the system with information about the environment and this information is essential for navigation.

Suddenly, Roosje, one of Francis's PhD students, curses from the back of the control room: "Shit!" Philipp runs back from one of his journeys to the living room and says, passing by, "I have a simple solution to this problem. Two minutes of work, but it doesn't work". I notice that Francis, with an absent look downwards, starts tapping nervously against the door of the wardrobe behind him. The robot, still immobile, now begins to utter sounds. I am not sure whether the system reacts to commands given by Philipp at the main terminal. Suddenly though, Philipp seems to react to the robot's sounds as he storms past me into the living room, singing with an ironical tone "Something is terribly wrong", then calls out "Yes!" The robot finally starts to move from the living room into the hallway, taking its starting position for the first pre-test this morning.

From this sequence, it becomes clear that integrating the robot does not only rely on a formulaic procedure but rather involves a spatially distributed, highly improvised practice of tinkering with both material and informational elements of the robot system. The way how Philipp handles the 'low-level connection problem' suggests that he cannot simply apply ready-made knowledge but has to improvise. Simple solutions do not seem to work in this case. Instead, Philipp needs to repeatedly hunker down tampering with the physical components inside the robot platform and sit in front of the main terminal typing requests as well as reconfiguring the software. In the process, other problems come up, components believed working suddenly malfunction and roboticists like Roosje and Philipp need to react to them in real time. Even more so, when the problem finally seems fixed, Roosje acknowledges that she does not really know why the robot moved. It could be, because Philipp has restarted it. In the end, these practices do not even result in a stock of secure knowledge, but rather in a tacit understanding that some problem has been solved for now.

Robots are commonly identified as autonomous, physically integrated machines, in this case, an about 1 ½ meter tall machine standing immobile in the apartment's living room. The field note above, however, suggests a different ontology of these machines. The 'robot' really denotes a *highly distributed system*, which spatially extends into the test apartment's infrastructure, i.e. via cables and wireless network connections. For example, the aforementioned main terminal in the control room is not only a device to operate the robot by remote control. It rather runs parts of the robot system on its hard drive and connects to other parts running on the test apartment's server infrastructure. This is a common way to 'outsource' particular computational processes in robotics[81]. This dependence of the system on staying interconnected with its 'external' components meant that during test runs every participant was requested to stop using Wi-Fi on devices that did not contribute to the operation of the robot system in order to save connection power.

The descriptions above have shown that, indeed, robots denote complex systems, which are not already integrated but rather need to be interfaced under localised circumstances and through highly improvised practices. Demonstrating an integrated robot system denotes a precarious achievement, since the system's techno-material 'integrity' is constantly on the verge of breaking apart. This especially comes from the fact that 'integration' seems to be an extraordinary event for roboticists, where formulaic knowledge does not suffice and improvisation and tinkering have to save the day. This becomes even more evident when roboticists are expected to render these systems operational in messy environments such as the test apartment.

5.2.2. Mundane courtesies: making the apartment robot-friendly

Robots might be complex systems but they need rather stable environments to operate. The test apartment is not stable, at least, not for robots. Mundane objects, like a carpet, environmental conditions such as lighting, or the user's unpredictable behaviour make hostile conditions for robots. Roboticists 'fix' these problems by way of rather mundane courtesies vis-à-vis robots, for example, by removing a carpet. Hence, the following subsection investigates the "ordinary technical practices" of roboticists (Vinck and Blanco 2003, pp. 2–3). They care for robots, by making the apartment (more or less) 'robot-friendly', that is, by re-arranging or reconfiguring a range of everyday, recalcitrant objects contained in "homelike conditions" of the test apartment (Innovation network website).

A place like the test apartment means chaos for a robot. A good example to understand this is computer vision, which should enable the robot to visually sense its environment[82]. For visual input the robot uses a Microsoft Kinect[83] on its head. This device features two cameras, one

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[81] This also includes 'sensory' processes, that is, connecting the robot to sensors in the test apartment's environment in order to render more ambient information available to the system.

[82] The following explanation is based on a conversation I had with Francis, the computer science professor, and Philipp, his master student (field note, 19/08/15).

[83] This device has its own interesting history. Initially only marketed as an entertainment product for the video games industry, especially for Microsoft's Xbox console, the mass-production of such a high-quality sensor also

that senses RGB (red, green, blue) colours and one that works via infrared. The notion of computer *vision* is actually deceptive here, because a robot does not ‘see’ like a human being. A robot does not simply recognise objects but perceives its environment digitally, as a distribution of values attached to pixels. From this, it can infer patterns, which are assigned to particular objects using machine learning algorithms. However, if those values change due to reflections on the object or different lighting conditions the algorithm yields completely different results. This often causes the robot to either recognise nothing at all or identify something else as an object (for example, a shadow on the table).

In the case of the test apartment, lighting was indeed an issue, since the rear wall of the living room, where most of the test runs were conducted, is completely glazed. That is a nightmare for vision, as Francis explains, because throughout the day lighting varies and this completely changes the environment the robot can recognise. The fact that the living room has big windows is part of the ‘realistic’ conditions, in which the project ought to make its robots work. The roboticists deal with this by way of mundane courtesies *vis-à-vis* the robot. For example, one of the services the robots should perform is called ‘object transportation’. Here, the robot should navigate to a particular place in the living room, a table, recognise an object, grasp it and bring it back to the user[84]. As a way to make it easier for the robot to distinguish and grasp the bottle from other objects (including a ‘control’ object in particular) they tidy up and shield part of the surroundings (see figures 11 & 12).

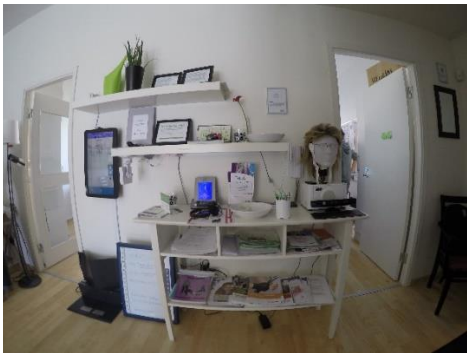

Figure 11 Side board and normal setup (image: author, 09/06/15)

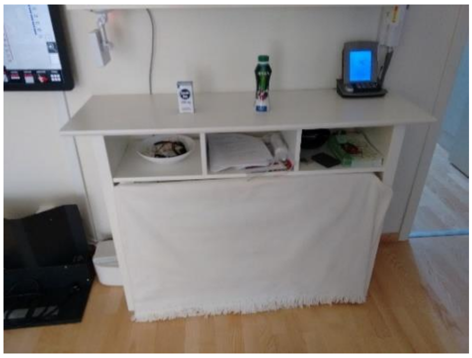

Figure 12 Side board during the realistic tests in August (image: author, 18/08/15)

meant that it massively dropped the cost for visual sensors for computer vision and robotics. Hence, Microsoft Kinects are still widely used in robotics development, see RBR staff 2012.

[84] This service is a ‘classic’ example of a robot service, commonly called ‘fetch-and-carry-task’. It denotes a pervasive vehicle to position robots’ usefulness in nearly all service robotics projects that aim to help the elderly in everyday life. This connects to the way assistive robotics and elderly care could interface within innovation policy discourse (see chapter 4.3.). Additionally, the interconnection between particular robotic tasks and elderly care plays into and is reproduced by staging effort undertaken by robots during realistic tests (see this chapter, section 5.3.).

The service of ‘object transportation’ required more of these courtesies. It often happened that the robot would move its grappler[85] off target or that it would lose the bottle after successfully grabbing it. In such instances, roboticists often come to its aid by, for example, putting the bottle back into the robot’s grappler or by displacing the bottle on the table when it is obvious that the robot will go off target. Such instances where roboticists directly intervene during experiments do not happen in secrecy neither from colleagues nor from users. Especially during the pre-tests where practically everyone was present during the test runs, this happens in plain sight. The project team acknowledges such instances often with laughter, while others reply with frustration.

The example of computer vision and the described robotic service shows that the milieu of the test apartment is a hostile place for robots. Obstacles that can cause the robot to fail abound. The tactics with which roboticists try to remove those obstacles take the form of rather mundane courtesies *vis-à-vis* the robot. In these instances, robots appear as fragile beings, which are in dire need of care. This stays in stark contrast to the imaginaries of European innovation policy where robots appear as powerful and autonomous beings ready to transform society. This impression continues in the following examples, where it becomes clear that these interfacing practices do not only act on singular objects but concern the whole milieu of the apartment.

Figure 13 Wardrobe at the front door of the apartment (image: author, 09/06/15)

Figure 14 Entrance area without carpets (image: author, 18/08/15)

One example for this is the apartment’s floor. Project members were required to take off their shoes before they entered the premises (see figure 13). Although Francis explained this rule to me as being rooted in the country’s culture where we tested, there was another reason for this. If people wanted to keep their shoes on, they had to put blue plastic bags around them. We had to prevent outside dirt from entering the apartment, not because people did like a clean floor

[85] Grappler is a term used in robotics for the robot’s claw-like actuators.

but because it could jam the robot's mechanics. Hence, this rule was less a cultural token gesture but rather another way to protect the robot from the mess of the outside world.

This 'mess' can be as trivial as a carpet. In the beginning of the pre-tests in June, the apartment featured a number of them (see figure 13). By the time the realistic tests were conducted in August, they had all disappeared (see figure 14). The reason for this was that the edges as well as the meshed surface of the carpets proofed to be a problem for the robot's wheels and, thus, impeded its mobility. Such issues were called "friction problems" (field note, 12/06/15). For instance, the robot struggled to get on top of the carpet that was lying in the corridor of the apartment, also the robot's starting and end position. Every time it navigated to or from that position it took a few accelerations for it to make it. On the carpet, the robot's mobility was limited, it moved much slower. „We have to get rid of this carpet. It's useless!" a roboticist exclaimed during one of the pre-tests (field note, 12/06/15). However, the issue is never really discussed among participants until the tests in August, when they decided to remove all of carpets from the apartment. The robot proves to be much more compatible with the slippery, laminate floor that this removal revealed. While the promise of advanced robots is to properly interact with people, in practice, it is often seemingly banal everyday objects, which bring robots' operation to a halt.

The example of the floor as well as the carpets allude to the fact that the pre-tests as well as the realistic tests in August followed a particular spatial order. While the specificities of this order varied across time and sometimes even from testrun to testrun, it had to be fixed before the robot would be tested. This involved the aforementioned starting and end position of the robot, which for most of the time was located in the apartment's corridor. It also involved the position, where the bottle would be picked up by the robot, mostly one of two tables in the apartment.

Finally, also the user mattered in making the robot work, especially their position within the apartment. During all the tests, which I have observed the user had to sit in a particular chair. This was not random but depended on a pressure sensor attached to the chair's bottom (see figure 15). To start with the service, the user would have to 'wake up' the robot, that is, utter a particular command ('Hey, robot!'). This initiated a sequence where the robot would locate the user and then head for that position. While the concept of the project stipulated to locate the user no matter where in the apartment and while this was technically feasible in principle, the user's position for the tests was fixed at all times. This example in particular, shows that the experimental situation is strategically simplified in order to allow for a more reliable outcome. It is in this sense that we need to understand the above roboticist's statement that carpets are “useless”. The test apartment denotes a hostile terrain for the robot, from which it needs to be protected. This means that the apartment must be turned into a more or less robot-friendly environment.

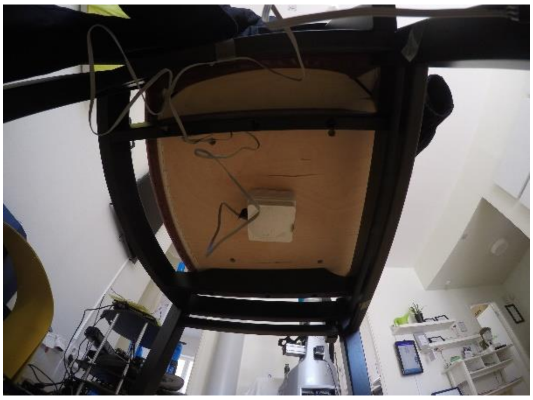

Figure 15 Motion sensor under the test subjects' chair, see the white box (image: author, 09/06/15)

In all these examples, we see how roboticists have to adapt the test apartment’s milieu to the needs of robots, that is, they have to make them as robot-friendly as possible. Despite the aforementioned status of robots as complex high-tech the kind of practices and things that this involves are rather ordinary. The precarious demonstrations together with these mundane courtesies let the robot appear as fragile being, which is constantly in dire need for care. This stays in stark contrast to the EU imaginaries of robots as powerful and autonomous machines ready to transform society and elderly care. By contrast, mundane things such as the edge of a carpet or a cloudy afternoon bring the high hopes of care robotics to a halt and let the Sisyphean labour of caring for robots begin.

5.2.3. Fit for robots: selecting, assessing, and training users

A robot-friendly milieu does not only contain material and technical elements but also human users. Before they can interact with the robot, they have to go through a procedure, in which users are selected, assessed, and trained. This denotes another instance where roboticists care for their robots in that they strive to admit only those users who are ‘fit’ to interact with the robot. This fitness is composed of the users’ autonomy, ability, and familiarity with the robot system.

Even before the users were admitted to the test apartment, they were *selected*. Even though the system was designed to assist the elderly, the pre-tests only featured young to middle-aged people (from around mid-twenties to end-forties). On top of that, they were recruited by the project members themselves. This meant that those users were, without exception, personally known to the roboticists, either as colleagues or friends. There were also instances where the project members themselves tried out the system, which they usually did right before test runs to see whether particular technical issues still persisted. Especially during the pre-tests when the system frequently failed due to 'low-level' technical issues, users' familiarity with the particular robot of the project or robots in general was an important resource for making robots work. This meant that relative familiarity was also the primary selection criterion in those first test runs.

During the tests in August however, the user groups should entirely consist of elderly people and be recruited by a representative of the local care facility[86]. The project's experimental protocol stipulated balanced quotas of these users based on different characteristics, like gender, age, and autonomy (experimental protocol, p. 12). In order to ensure those quotas, the users needed to be *assessed* by way of a range of different gerontological evaluations and scales. Especially, the users' autonomy was deemed pivotal here and it meant their predisposition with assistive technologies as well as their physical and mental ability to perform activities of daily living[87]. The project distinguishes three levels of autonomy: low, middle and high level. According to the experimental protocol, test subjects should equally distribute among those three categories (ibid.). This requirement sparked a controversy among participants. Karl, a sociologist who works for the UX company, argued for following those quotas in order to represent all possible users, especially those who are disabled in their everyday life by severe mental and physical impairments. He argued that feedback from these users could yield important insights into how robots can help those people. Most of the other technical partners, however, opposed this. Francis feared that with such users the experiments "will be (…) extremely more likely to fail, because … the technology was not designed with those users in mind" (Recording team briefing, 09/06/15). Charles, an assistant professor in computer science from the local university, seconds Francis by arguing that "[t]his is the end of the loop meaning when this is done we are done" (ibid.). Feedback from users with low autonomy level would therefore not make a difference *vis-à-vis* the robot system. Ultimately, what counts is to make

[86] The care facility's building also hosted the test apartment. I will cater to this circumstance and the recruitment procedure in more detail in section 5.3.

[87] This is evaluated by way of assessments contained in the 'recruitment protocol' (experimental protocol, pp. 28-32). This includes a questionnaire where interviewees should rate their current abilities of daily living (e.g. hearing, remembering, mobility) as well as their current and estimated future use of assistive technologies or other supports. It also features an examination of their mental state, which tests the cognitive abilities of the potential subjects. Finally, the recruitment contains an assessment based on the Lawton Instrumental Activities of Daily Living metric (e.g. ability to use a telephone, shopping or laundry), a gerontological scale for evaluating elderly peoples' independence in everyday life, see Lawton and Brody 1969. 'Autonomy' then is a score that is derived from all these tests.

the robot work and to prevent it from failing – autonomous robots need autonomous people. This denotes another instance, where roboticists care for robots in that they 'protect' them from users, who, in their eyes, are not fit to interact with the system.

Contrary to the promise of social robotics "to make machines adapt to people's needs and not the other way around" (Heeren 2013, p. 5), roboticists select and assess potential users on the basis of their ability to interact with the system. This, however, does not yet ensure that users are fully prepared. Before they are admitted to interact with the robot, they need to be *trained* through a procedure that can range from 25 to over 40 minutes. This so-called "user training" (experimental protocol, pp. 71-72) does not take place within the robot's test apartment but rather in another compound of rooms in the same building, where the team usually eats lunch and holds meetings.

User training

Field note (10/06/15)

Karl and the test subject sit at the kitchen table. He explains to her the different user interfaces of the robot. She can control the robot via a tablet's touchscreen. Karl takes the tablet and prompts the test person to tap on it. He points out an area on the tablet screen and explains that she can call the robot by pressing a button on the graphic user interface. She can also control the robot via speech input. 'If you want, you can try.' He adds: 'The main command is 'Hey, Robo', because Robo is the name of the robot.' He points out to the test person that most of the answers to questions by the robot are 'Yes' and 'No' answers. The commands are the same as last week[88], he says.

During the user training, the interviewer explains to the user how she should control the system. Here, Karl does not simply present the robot's functionalities, what the robot can do, but also conveys the prescribed way of using the robot, for example, by saying that most of the robot's questions require either 'yes' or 'now' answers. This implicitly blames the user for failed HRI, that is, for not concurring with the robot's script (Akrich 1992). Trying out the robot's user interfaces hands-on then is a means to internalise these instructions and to adapt the user's behaviour to the robot's needs. This is what Woolgar (1991) has described as 'configuring the user'. Engineers attempt to direct and discipline users in the use of technologies, for example, through user manuals or other types of instructions. However, this only captures half of the interfacing process under operation here. This is to say that the interviewer also repeatedly tries to take away pressure from the user and to prevent her from thinking that she could do

[88] Apparently, the test person has already tested the robot in the previous week (before I arrived on-site).

something wrong. For example, in a user training on the next day, he tells the user that "You can try whatever you want. You can't destroy anything" (field note, 11/06/15). Here, the job of the interviewer is not simply to introduce the user to the robot but also to engender "trust in the interviewer and test … [and to minimise] reservations in the handling of the technical devices" (experimental protocol, p. 72). Granting the user freedom in experimenting and getting to know the system is an important part of these experiments. Ultimately, they are a way to render the system available for the user by at least suggesting that it can, to a certain extent, adapt to the user's behaviour.

This ambivalence becomes even clearer in another controversy among participants that sparked with regard to so-called "use-case cards" (ibid., pp. 73-75). Such cards contain a brief description of what the user can expect from a service as well as a detailed account of its sequential order. The latter part bothered some of the roboticists since it conveys a very linear image of the interaction with the robot. On one hand, the robot needs a rather structured dialogue, as we will see in the following section, but, on other hand, it is also flexible to a certain extent. They fear that this capability – the robot's relative flexibility – is not acknowledged enough in the use cards. Another issue is that users need to hold the printed use cards in their hands and often need to sort through them before choosing a particular service. Some fear that this would distract the user from the robot and thus inhibit indeterminate interaction. In the end, the use cards remain part of the user training and the experiments but the controversy shows that the training of the user is not simply a question of linear configuration but involves a conflictual process of negotiating between more closed and open configurations of possibilities to interface differently fit users and technical devices.

Nevertheless, when compared with the grand vision of assistive robots enabling the elderly to live more independently, the described procedures of selecting, assessing, and training users turn those visions upside down. Elderly peoples' ability to be independent is, if anything, not simply the result of the interaction with robots but also its prerequisite. Robots need people that are fit to use them, and this fitness is the result of a long chain of interfacing processes that, on one hand, adapt people's behaviour to robots' needs but that also render robots available for people as they try to accommodate (albeit restricted) levels of indeterminacy within HRI.

5.2.4. Corridors of interaction: calibrating 'speech' and voices

The way in which users and robots are prepared for one another does not stop at rather general instructions as described in the case of the project's user training. Rather, their mutual interfacing seems to become more and more specific the closer they get. As an example, I will discuss the speech user interface, which affords a meticulous calibration procedure and the microphysical adjustment of a myriad of elements, both human and non-human. From it arise, what I would like to call, *corridors of interaction*. This means that roboticists as well as users and the robot system itself produce controlled but not completely determined avenues, through which interconnections between robots and people can be enacted. To illustrate this, I will take the example of the speech interface used as the primary modality through which users would interact with the robot system.

Roughly, the user interface consisted of a speech recognition software, a database of vocabulary, an algorithm, a microphone, through which users could speak to the robot, and a receiver module, which was plugged into the computer running the software. On one hand, it was supposed to be the primary channel, through which users and the robot should interact with one another. On other hand, it was one of the most common sources for failure of HRI. The following field note shows how hard and laborious it is for roboticists but also for users to make HRI via speech work. The following field note introduces two other team members, Carol and Andrea, who developed the speech recognition software and who were present only during the first two days of the pre-tests in June.

Out of sync

Field note (09/06/15)

During test runs, Carol and Andrea position themselves sitting on the couch in the living room right next to the chair, on which the test subject takes place while testing the robot. In front of them on the table sits the laptop running speech recognition software. On its screen, they monitor what kind of information the system recognises and how it feeds back into the system. They compare the situation on their screen with the user-robot interaction next to them.

During the test runs, interaction repeatedly stalls. This often creates long pauses, during which the user simply waits for a response on the part of the robot. In such situations, Carol and Andrea repeatedly instruct the test subject what to say to the robot. "You have to say 'No'!", "Please try again!" or "Again, once again!" Next to such instructions, they also intervene into the way the test subject holds the microphone in their hand. Andrea tells users to "hold the microphone like this" indicating the middle of his chest. In another instance, Carol points out that the microphone is too close to the user's mouth. The test run continues, marked by many pauses, waits, and instructions.

After the test run is over, Andrea exclaims “Everything that could go wrong, did go wrong.” Everyone in the team agrees that this test run was not good. Francis explains “If you say something wrong, everything goes out of sync.” And: “The girl said things in the wrong order [he laughs]. I mean, for us, because we never tested it that way. For example, the sentence ‘Hey, Robot’ restarted the whole sequence, even though it should not.” Roosje adds that the robot seemed not to be prepared for the test subject’s question “What did you say?”

Interaction via ‘speech’, as it was abbreviated by project members, repeatedly broke down. This had many reasons. For example, it could be that the system failed to recognise the user’s voice or that the microphone recorded a conversation of the user with the interviewer not intended for the interaction with the robot. The system then interpreted it as a command directed at a particular service. This meant that the experiments were marked by recurrent pauses and breakdowns associated with speech, while the reasons for them often remained concealed even for the team members themselves. They could not look into the ‘black box’ of the speech user interface, especially when the two people responsible for it left the premises on the third day of the pre-tests. What becomes visible as well in the upper fieldnote is how team members dealt with those problems and how they attempted to overcome them in practice. Here the two speech experts, Carol and Andrea, try to keep the experiment running by disciplining different modalities of how the test subject should or should not use the speech interface. In this logic, they correct the user’s behaviour according to what they deem the robot system needs in order to proceed. This could allude to the right vocabulary or the right distance between microphone and mouth. Consequently, it is primarily the user who is blamed to ‘say things in the wrong order’, which causes the different elements to go ‘out of sync’.

On one hand, this represents another example for how engineers configure users (Woolgar 1991) or inscribe their technologies (Akrich 1992) in order to render them compatible with one another. However, this does not capture the full scope of what is going on here, because at the same time much of the work during these experiments is invested in the technological components and their adjustment to other components as well as the events of the experiments. The team members “need to make the system more robust”, as Francis tells me after another test run with speech problems (Field note 09/06/15). Also, Roosje’s wording in the upper field note suggests that roboticists see the problem ‘inside’ the robot as well: ‘the robot seemed not to be prepared’. The robot system and its components are not carved in stone, at least not entirely. Engineers and computer scientists in the control room are busy to find any supposed errors *in* the system and to reconfigure it accordingly. Furthermore, the very condition of possibility that the robot system can recognise the test subject’s voice at all lies in a series of interactions between native speakers and the voice recognition algorithm, which was extensively trained before the experiments. Andrea and his team indeed work to prepare the robot system, too. Only that this preparation resides mostly outside the immediate encounters produced in the test apartment. They have lasted and continued throughout the whole course of the project.

It is instructive to see both of these processes at once in order to grasp the reciprocity, with which the different elements of this milieu get 'out of sync' respectively get back into sync again. To understand the latter I will now turn to another particular procedure that users (and the system) have to go through shortly before their 'first contact' with the robot. This procedure does not aim to discipline the vocabulary or posture of users but to tune modalities of speaking. I call this the calibration procedure.

The calibration procedure

Field note (12/06/15)

After the user training and before the interviewer and the test person actually enter the test apartment's living room, they both turn right and enter the control room. They are going to pre-test the speech interface. One of the team members sitting in the control room hands the microphone, a small cylindrical object, about 8 cm in length, to the test person. She should utter the command calling the robot from its starting position. 'Hey Robo.' As an answer someone remarks: 'A bit louder, please!' The test person repeats, this time a bit louder. Everybody looks at the screen in front of them, on which a black-and-white console writes lines of text. 'No, it hasn't accepted,' one of the roboticists declares. This procedure repeats itself a few times until it finally works.

This field note shows calibration affords roboticists to act on a whole milieu of distributed surfaces to prevent breakdowns and interferences. Here, the primary attention of the roboticists lies on the screen and the black-and-white console. The feedback they get from it sets the timing of the situation and gradually localises a correct corridor of speaking with the robot. Only now, it is not about vocabulary or posture but rather about how the test person should use her voice. This does not mean that a correct way of speaking would exist beforehand. Rather, the availability of the user's vocal tract is product of a more or less long-lasting, iterative process of mutual interconnecting. In this situation, roboticists become scopic readers and interpreters of the feedback that is reported by the speech recognition software on the console. On the basis of this feedback, roboticists work as some sort of switch translating the console's output into logopaedic instructions insofar as they stimulate the user to continuously control her vocal tract.

Through this kind of repetitive, iteratively unfolding calibration loop participants reach an acceptable corridor of interaction between the robot, the roboticists, as well as the user.

Hence, the separation of 'wrong' ways of speaking rests on practices of interfacing, which aim to render recalcitrant surfaces available for one another. It is important to note here that this is not simply about normalisation or discipline (Foucault 1995) but about the reciprocal adjustment and interconnection of the various distributed surfaces that feature as part of this milieu (incl. the roboticists themselves). The voice of the user is not simply disciplined in relation to a previously apparent norm. Nobody of the participants, incl. the roboticists, know exactly how the system will react to certain inputs and when the corridor of acceptance is reached. It is precisely because of this that such laborious, microphysical practices of calibration are needed: not to conform to the system but to *produce* that norm in the first place. The fact that at the end of the procedure HRI 'finally works' does not mean that it will actually work in future instances. Those different elements, the microphone, the software, the receiver, the user's vocal tract or posture may stop to be compliant and new efforts to interface may be needed. Or, it could be that other interconnections, undesirable ones, may need to be cut off.

Again, the result of these interfacing practices is not a fixed way of using the system but rather a more or less acceptable and ultimately uncertain *corridor of interaction*. For example, while the above example may suggest that users should speak very precise and in that sense 'robotic' to the robot, this is not necessarily the case. In another instance, a user talked to the robot in a very mechanical and monotonous way. The system had trouble recognising this way of speaking. Roboticists responded to this by urging the user to speak more 'natural', since they argued that the system is able to understand "normal speech" (Field note, 17/08/15). Coming from the analysis above, the trouble with this statement is of course that what 'normal speech' means in practice is not apparent and needs to be reiterated again and again via meticulous calibration.

5.2.5. The techno-materiality of human-robot interaction

The promise of assistive robots is that they would take over domestic tasks for the elderly to allow them to live more independently for longer. The autonomy and intelligence of such robot systems is supposed to allow them to adapt to the elderly's needs and to raise their quality of life. However, the empirical analysis of the pre-tests suggests otherwise: rather then robots caring for people we witness numerous instances where people must care for robots in order to make them work in everyday environments such as in an assisted living apartment. While the vision of RobotCare is often depicted as yielding a "substantial increase in efficiency of care and independence of elderly people" (European Commission 2009b, p. 73), we indeed witness shifts in who/what is caring for whom/what. In the prototypical milieu of the test apartment, technology becomes the object of care (while leaving a big question mark whether it can be considered an agent of care). As in many cases this care involves an asymmetry (Puig de la Bellacasa 2011, p. 94), in which robots do not figure as autonomous, intelligent beings but rather as frail and needy components of a whole milieu of elements that need to be in place in order to make even the most trivial interconnections between robots and people possible.

The caring practices described in this section thus do not relate to a prototypical object, a piece of technology such as a robot. Rather, the prototypical here alludes to the manifold practices, in which a range of elements, robotic components, human bodies, light, and speech, are meticulously rendered available for one another. In this sense, when talking about the prototype of this robotics project, it is really a whole *milieu* that is prototyped here. Interfacing, then, means to re-arrange and re-configure this milieu in such a way that particular interconnections between robots, people and their environment may come into being.

5.3. Staging robots for care

In HRI experiments, roboticists do not only aim to make their robots work in a technical sense. Under the conditions of technoscience (Nordmann 2011) and the expectation of innovation policy to increasingly interface science and society (Gibbons et al. 1994; Nowotny et al. 2001) roboticists are confronted with and subscribe to the task to demonstrate feasibility and functionality of their robots *vis-à-vis* elderly care . However, as we have seen in the previous section, to establish interconnections between people, robots and care-like environments is a very fragile process ridden with failure, especially when compared to the promise and vision of RobotCare as it circulates in European innovation policy discourse. This results in the need to temporarily *stage* such interconnections through "techno-scientific dramas" (Möllers 2016). Thus, HRI experiments involve a range of theatrical practices and performances, through which roboticists aim to install the conditions for 'plausible' interconnections between robotics and elderly care, albeit these dramas frequently break down in practice.

This analysis' entry point is the project's second set of 'realistic tests', which I attended during my field trip in August 2015. Here, the primary focus of project members lied on testing the robots and their services with elderly users in 'realistic' environments and 'fictitious' scenarios[89]. The realism of these experiments is positioned as grounding R&D in the 'reality' of care and, consequently, as yielding better technology for it. However, my analysis shows that contrary to simply representing the reality of elderly care the experiments' realism denotes a prop for staging robotics as a viable solution for elderly care.

5.3.1. Interventions from behind the scenes: coordinating HRI experiments

The empirical basis for the following analysis are the realistic tests in August. Here, we see a considerable shift in how these tests are conducted and to what ends. While the pre-tests' purpose was mainly to integrate the robot system and to make it work with (younger, middle-aged) test subjects, the realistic tests did not allow for as much integration or repair work to take place. For every day that I was present one to two test runs were scheduled. The focus lied more on demonstrating the different robot services with elderly users under realistic conditions and letting them evaluate the HRI by way of a questionnaire after each test run. These results would be part of the final deliverables of the project, which ought to be reported to the European Commission. This came with a different experimental regime of how to conduct the tests, namely with regard to who was present in the test apartment and, more specifically, how roboticists could observe the tests. During the pre-tests almost all the project partners were present (at least one of each team). Additionally, project members would directly witness the test runs by sitting dispersed in the living room, some even right next to the test subject. This often meant that ten to fifteen people crowded in the living room. This was due to the fact that all project partners should be able to witness the system's performance and to identify possible problems in the interaction with the user.

The realistic tests changed this radically. It was only the team members from the local university and me (as representative of the UX company's team) who oversaw the realistic tests. These residual participants had to remain "'invisible' and … monitor the situation through a screen from a second room" (experimental protocol, p. 68), the control room (see figure 16). They were charged with intervening into the experiments, if needed. Only the interviewer, specially prepared for this task, should be visible to the elderly users[90]. The realistic tests, thus, introduce

[89] This is different from the pre-tests in June 2015 where the focus lied mainly on making the robot system work and, to achieve that, mostly 'protecting' the robot from messy circumstances. This, for example, means that the robot system was only tested with younger users and not, as in the case of the realistic tests, with elderly users.

[90] There was an exception. Francis, the computer scientist professor and lab leader of the team that conducted the tests, hid in the back of apartment in the corner between bed room and bathroom. He observed the events of the tests and recorded his observations in a notebook that he would later use as the basis for discussing problems with his colleagues. Occasionally, he would also talk to the test subjects, mostly right before they entered and exited

a spatial division between the control room and the rest of the apartment, between roboticists' activities and the human-robot interaction supervised by the interviewer.

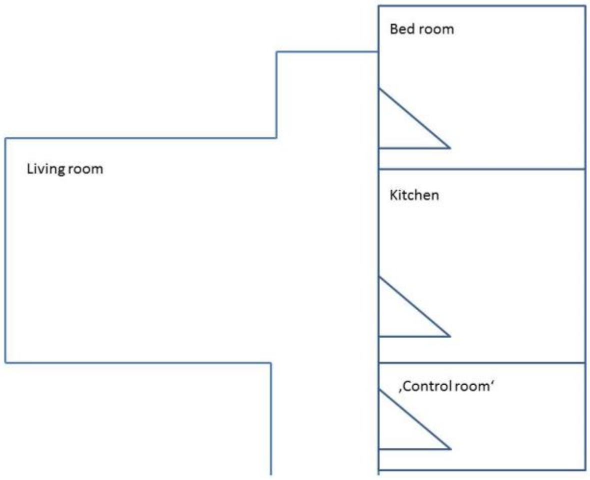

Figure 16 Layout of the test apartment

This spatial division into front stage and backstage activities denotes the first theatrical component of the realistic tests (Möllers 2016, pp. 353–354). The user should not see nor hear what roboticists did to make the experiments work, i.e. the technical activities and interventions from behind the scenes. However, this effect of realistic tests was not a stable affair but was rather threatened by roboticists, who violated this division time and time again. For example, the atmosphere in the control room was, as long as nothing went terribly wrong, quite relaxed and jolly. Roboticists would joke about the experiment in the living room and the many glitches that would still frequently occur. This sometimes resulted in full-throated laughter by them. After one of such instances and after the test was finished Francis, the lab leader, came into the control room, furious, and rebuked them to stay quiet. The reason for his irritation was the fact that their laughter could be heard in the living room, which disturbed the experiment. Another example are visible interventions. If the robot system exhibited an error that could not be repaired remotely, roboticists would, albeit seldom, exit the control room and enter the living room to, for example, force a restart on the robot platform. In these instances, they would not talk to neither the interviewer nor the user. These glitches show a paradox of staging in this situation: in order to maintain the theatrical order of realistic tests it has to be temporarily suspended.

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the test apartment. This is only one of many exceptions to the rule of the spatial divide between front stage and backstage. I will talk about these in more detail later.

While these visible (or hearable) interventions become explicit to the user and were perceived as violations of the dramaturgical order, the realistic tests afforded a number of *invisible* interventions to coordinate the HRI experiments. Due to their spatial seclusion in the control room roboticists' access to the living room is enabled and constrained by a number of different media. The experiments were recorded by four cameras and streamed onto one fourfold split screen in the control room. Computational processes 'inside' the robot system could be accessed and controlled on two further screens, the main terminal as well as another laptop, on which the speech recognition software was running. Finally, one of the roboticists was charged with the task of communicating with the interviewer via Skype, mainly to issue instructions and updates from the control room. In this sense the experimental situation becomes a "synthetic situation" (Knorr-Cetina 2014, 2009), whose coordination owes itself to the interfacing of different human and non-human actors, both in the control and the living room respectively in the kitchen.

In the control room, the urgent question among roboticists was mostly how to make sense of the events in the living room and how to react (at times, intervene) accordingly. Here, the different media mentioned above did not simply grant access to these events but rather often produced or at least suggested divergent accounts of what was going on. This occurred for example when one of the test subjects issued the so-called escort service. In it, the user would stand up while the robot turns around offering to the user a handle fastened to the robot's back. The user can then hang on to the robot and stir it in the desired direction. This mostly meant that they had a walk around the living room or the kitchen. In the situation concerned here, the user had asked the robot to escort him outside the apartment[91]. When the user stood up and the robot turned around. From the camera stream it seemed clear that this was the escort service and that it worked fine. However, when Philipp, the computer science master student, checked on the main terminal, he countered that the escort service is not working and that the robot is going back to its 'home' position: "He's going home. He's not escorting, he's driving!" (Video transcript, 16/08/15).

This meant that the escort service could not be continued but needed to be interrupted, the system restarted. This did not only mean that Philipp had to intervene into the computational processes via the main terminal but also that the roboticist in charge of the Skype communication, Charles, ought to convey this to the interviewer as shown by the following transcript of the Skype chat between them:

[91] This was after the robot had informed the user about a gas leak, which denotes another service under testing. I will analyse this particular situation more closely in section 5.3.4.

Artificial vision is difficult

Skype log (16/08/15)

[11:08:26] Charles: escort not working

[11:10:09] Interviewer: possible to bring medicin?

[11:10:14] Interviewer: or only water?

[11:13:09] Charles: it should be, but he messed up

[11:13:15] Interviewer: ok

[11:13:41] Charles: so it has failed - no problem, you can explain that artificial vision is difficult ☺ (smiley)

The transcript shows that not only roboticists' accounts in the control room, also their account and the interviewer's interpretation of the situation had to be interfaced. The interviewer constantly reassures himself of the 'rightness' of his judgement about the situation. Can the robot bring medicine or only water? Well, in principle yes but something got in the way again. The chat transcript shows how time-consuming this was. To communicate with Charles the interviewer did not have a handheld device with him but had to go back and forth between living room and kitchen where he had set up his own laptop. To coordinate this way often took minutes as the Skype log shows. This was due to the fact that the interviewer was often caught up with the user and the experiment and that Charles sometimes could not make sense of what the interviewer wrote and, thus, had to wait for further explanation. As a result, both had to be economical, i.e. very selective about what they communicated and what not. For this, they agreed on some code words, such as 'crash', which simply meant that something was wrong and the system was not operational. Reasons for malfunction were only conveyed in exceptional cases, for example, when the experimental situation afforded conversational repairs. Here, the transcript exhibits such an instance, where Charles offers an albeit general explanation for why the robot did not work: "artificial vision is difficult" (Skype log, 16/08/15). Hence, the interviewer is instructed to repair the situation by at least verbally revealing the backstage. This shows how the backstage, while remaining invisible for most of the time, is also tactically revealed as a way to indicate the prototypical stage of development.

The staging of HRI experiments affords both to impose and to transgress the spatial division of backstage and front stage. These interventions differ from the kind of interventions we have encountered in the previous section in the sense that the former should not be recognised by users, and thus must be rendered invisible and muted as far as possible. This affords the intricate coordination of the experiment as a synthetic situation, where roboticists and the interviewer need to interface via cameras, screens and chat rooms.

5.3.2. *People and robots 'at home': staging the world of users*

So, while the backstage hosts and conceals interventions from behind the scenes, the front stage should emulate the world of users, namely, the "homelike conditions" under which they supposedly live (Innovation network website). Staging robots and people 'at home' denotes the central vehicle, through which roboticists position their research and development as "grounded in reality" (ibid.). This 'reality' is not given but staged, on one hand, by admitting only particular, balanced quotas of elderly people to the tests and, on other hand, by establishing and maintaining a 'home-like' ambiance in the test apartment. It is through these staging practices that roboticists assemble the conditions for "techno-scientific dramas" to take effect (Möllers 2016). These stagings of robots and people in home-like environments aim to interface the highly context-dependent experimental practice of robotics with European innovation politics' push for the accelerated commercialisation of robotics in a supposedly de-contextualised market.

For the pre-tests in June, project members recruited only younger users, who often were familiar either to project members or robot technology or both. I have already analysed these phenomena as instances where roboticists care for their robots by protecting them from elderly people in general or at least from those with 'low autonomy', who, due to their lack of 'fitness', are deemed incompatible with the system (more on users' autonomy and fitness in the next subsection). For the realistic tests in August, however, it was required by the project's experimental protocol (and reviewers) to recruit 'real' elderly users with different (also low) levels of physical and mental autonomy. Next to caring for robots, there is also a different rationale gearing this selection of test subjects, i.e. to 'objectively' represent the lifeworld or market of elderly users by including balanced quotas of their characteristics. This denotes the counter position to roboticists' concerns about asking too much of the system. Karl, the UX company employee and trained sociologist, summarises this counter position as follows:

> "… all these different groups have different lifestyles and different needs in their life and so we just use the whole world, the whole viewings on the world from specific groups, which are really relevant for assistive robotic systems." (Recording team briefing, 09/06/15)

So, sampling balanced quotas of elderly people (regarding their autonomy, gender, age etc.) aims to represent the 'whole world' of elderly people and their care. Within this rationale, for assistive robotics to access this everyday life experience means to expose robots to a representative variety of elderly people. As described in the previous section, this 'world' has to be constructed via a number of inclusion criteria (older than 65, no psychiatric illness etc.), tests and evaluation processes, where elderly people assess themselves and are assessed by recruitment personnel. During the realistic tests, a total of 20 subjects should participate, which were to exhibit a certain distribution of characteristics (e.g. 60% female, 40% male; even distribution across different levels of autonomy). Hence, the world of elderly people needs to be staged by way of statistical sampling, which renders the question of inducing that 'reality' in the test apartment dependent on scientific, generalizable facts about the overall population. For example, the experimental protocol bases the criterion that the sample needs to consist of 60% women on the demography of the European elderly population in general.

Next to statistical sampling it is also the very practice of recruiting elderly people itself that plays into this. Recruitment is situated within the local care facility, where the test apartment is located. Most of the elderly people participating in the tests are recruited from that facility. This is taken as a guarantor for being "in close proximity to end-users" (Innovation network website). However, it does not mean that elderly people are simply available for these tests. Rather, as a representative of the care facility explains in a meeting, they need to be found, interested, and activated to make them suitable test subjects, that is, representatives of a generalised elderly world. Hence, actually recruiting people is a precarious process, in which, at times, the *a priori* criteria of the experimental protocol need to be adapted or circumvented. This goes to show that the realistic tests are not grounded in reality of elderly people nor of the care facility *per se*. Rather, recruitment and sampling practices are situated within and mediated by the experimental circumstances of the project. The reality of balanced quotas is thus a *staged reality*, which is grounded in carefully selecting and laboriously mobilising the 'right' people for these tests.

Next to composing user quotas, also the test apartment itself is designed to represent the world of elderly people and their care. This is said to be achieved by an interior design of the apartment, which emulates "homelike environments" (Innovation network website). The facility is not called test *apartment* for nothing. It comprises a number of rooms, most of which represent particular functions of daily life. For instance, there is a kitchen, a bedroom, a bathroom, and a living room. Staging here means that the ambiance of the everyday living environment is not left to chance but rather owes itself to careful arrangement and maintenance of a particular order of 'home-like' props. This order is prescribed by the apartment's manual folder. It specifies a number of daily routines, which should be followed by researchers using the apartment. For example, the apartment should be kept in a state that is "pleasant and inviting" to guests (Apartment manual). This 'state' is not random but rather prescribed by pictures contained in a folder asking participants to keep a 'pleasant and inviting' order in the apartment (see figures 17 & 18). This order includes furniture, art decoration on the wall and the position of a plant on the windowsill (see figure 17). The manual also makes visible a range

Figure 17 Photograph taken from the apartment manual (image: author, 10/06/15)

Figure 18 Photograph taken of the living room setup also contained in the apartment manual (image: author, 10/06/15)

of other maintenance requirements, such as, what needs to be considered about cleaning as well as tidying up the apartment, about charging the apartment's equipment, and scheduling for visits. These practices show how the 'home-like' ambiance of the apartment owes itself to the meticulous arrangement of props, whose order and state need to be maintained throughout the experiments.

These stagings of robots and people in home-like environments aim to interface innovation politics' endeavours to push for the commercialisation of robotics in a de-contextualised market with the highly context-dependent experimental practice of robotics. The former rationale becomes clear when looking at the wider institutional milieu of the test apartment. It is the result of and managed by a local public-private partnership funded, amongst others, by the European Union. In this context, the test apartment's realism is positioned as allowing for "better and more effective solutions [in elderly care], often with shorter development time and a faster product launch" (Innovation network website). Realistic tests such as the ones described in this chapter are seen as "the shortcut" (ibid.) to accelerate the introduction of assistive robotics into a Europe-wide "silver economy" (European Commission 2015b). This is despite the fact that, as shown by this chapter, the experimental practice of assistive robotics is highly localised, tied to the specific circumstances present during those tests and highly fragile. However, staging these circumstances as representative of elderly peoples' lifeworld allows for the purification of these tests and their translation into ready-made 'proofs' of RobotCare's viability (Latour 1987). The procedural conditions for this being the many backstage practices I have just described. It is through these theatrical practices that the techno-scientific drama of HRI can take effect.

5.3.3. *Narrative devices: imagining care with robots*

Users are not only theatrical requisites for staging robots for care but also active parts in this process. On one hand, they are mobilised as witnesses of the vision of RobotCare by a number of narrative devices, such as promotional video material, fictitious scenarios and verbal as well as written instructions. Through these devices, roboticists aim to stimulate users to imagine themselves as part of that vision, that is, being cared for by robots. On other hand, users do not only imagine care with robots but also need to learn to act with robots, that is, to let themselves be helped by them. While this enactment is very precarious its success lies in the creative alignment of robotic services thus engendering human-robot choreographies.

Narrative devices are material-discursive techniques of embedding robots, people and care environments within story lines in order to render the interconnection of robotics and care plausible. The first narrative device investigated here, is the project's promotional video. This film of about 16 minutes features prominently on the project's website and is available on a popular video platform. It is used for public presentations and framed as an outreach activity. Most importantly for my argument here, it is shown to users during the user training before the experiments as "a general introduction before the testing" (experimental protocol, p. 67). In this context, only a part of the whole video is shown, a snippet of 4 minutes about the scenario of grocery shopping. Contrary to the experimental protocol's claim to simply prepare users for the experiments, the video does much more than that, namely, it *stages* RobotCare as a plausible and fictional reality.

Morning routine

Descriptive protocol[92] of the project's promotional video

The sequence starts with a shot of an opening blind letting in the light of dawn. With it, a piano jingle fades in. It will underscore the whole sequence gradually intensifying as more instruments are joining in the melody.

The camera cuts to an almost completely black loading screen, supposedly 'inside' the robot, featuring the robot's name in the middle. As a round progress bar reaches '100%', the screen reveals a blurry view of the robot's surrounding as it boots up. This 'view' is framed by, what seems to represent, the robot's visual interface featuring a number of different graphs, symbols and even a world map in the low right corner.

[92] This is not a video transcript but a rough and selective description of what is going on in the video. The following description mainly follows the particular camera perspectives. Every change of paragraph indicates a cut from one camera shot to another.

> The camera cuts to a medium shot of a room that features a kitchen counter in the background to the left and a dining table in the foreground to the right. Not much indicates that somebody actually uses this kitchen for cooking or else, except for a grey-haired man having his breakfast at the dining table to the right. The camera focuses on the moving robot, the man remains blurred. The elderly turns his head towards the robot uttering something, after which the robot immediately starts to move backwards, turns, and moves towards him, while the man picks up a small bowl from the table supposedly sugaring his tea or coffee. When the robot arrives to his left, the robot turns its left side towards him revealing a tablet that is fastened to a mount on its casing. At the very same time, the man turns himself towards the tablet without looking at the robot at all.

First, the aesthetic register of the video does less fit a demonstration video then a TV ad. Here, the extensive use of jingle music, the polished production, as well as the almost artistic use of filming techniques and shots stand out from other videos produced in the context of non-commercial R&D projects. Most importantly, the video does not simply describe the robot and the services, let alone, what users can expect from it in the experiments but rather it *narrates* a story around it, which I have called ‘morning routine’. Take for example, the short sequence at the start, where the light of dawn falls onto the robot ‘waking’ it up. Or, the cut ‘into’ the robot depicting the world from the robot’s inside ‘perspective’. Also, the props of this video, the kitchen and the dining table embed the interaction of robot and user in an everyday setting of which the robot seemst to be a self-evident part. Finally, the user appearing in this sequence is not random but rather plays a particular persona in this story: the single, independent elderly man living solitarily at home. These narrative devices embed both, robot and user, into a fictional world, where robotic assistance of the elderly is real and plausible. The interconnection of robots and elderly people, of robotics and elderly care denotes, what Kirby (2010) calls, a “diegetic prototype”, that is, something that exists as reality in a fictional world. Hence, the video does not simply introduce the user to the robot but rather stimulates him or her to imagine a whole world where robots are intrinsic part to the everyday life of elderly people and where this lifestyle complies with a particular model of care – independent living (Winthereik et al. 2008). As discussed in the previous chapter this model is not at all universal but owes itself to the selective appropriation within European innovation policy discourse as a vehicle to legitimise R&D in assistive technology (see section 4.3.).

The scenarios depicted in the promotional video are based on the “fictitious scenarios” (experimental Protocol, p. 67) that structure the experiments. These scenarios are described at length in the experimental protocol (see figure 19). Next to listing the ‘technological actors’ (sic!; e.g. robot platform, sensor network) and ‘human actors’ (e.g. user, caregivers) as well as the different robotic services and stakeholders involved in these scenarios, the descriptions also contain elaborate narrative accounts of what the situation of the user is like, as the following example shows.

SCENARIO 1	**Prevention (Health)**
SHORT DESCRIPTION	User has the flu and his relatives are on holiday, so he needs someone who provides him the drug, because he cannot leave his bed. Thus, he needs also someone to bring food or drinks from the fridge. It is very important that he remembers to take medicine when appropriate, so it is crucial to monitor the assumption and give warnings, when necessary. Their sons are worried due to the distance, so the user calls them often for making them aware of his health status. To going to the toilet, he needs to be supported due to a sense of instability he has.

Figure 19 Narrative description of scenario 1 as contained in the experimental protocol (taken from the project’s experimental protocol, p. 1)

Such descriptions again assemble the social and spatial milieu of the user, in which robotic services can intervene. The scenario description stages a precarious situation (‘their sons are worried’), in which human carers are unavailable (‘his relatives are on holiday’) or completely absent (e.g. professional caregivers) and the user has certain needs (‘he needs someone to bring food or drinks’). This concisely staged situation is then ‘paired’ with particular services (e.g. object transportation), which the robot together with the other technological actors can provide. The description of such fictitious scenarios denotes, thus, another instance where roboticists stage robots for care or, to be more precise, create very particular fictitious situations, in which robotic services can make sense. This interfacing is enabled by, on one hand, specifying very particular situations and, on other hand, by rendering invisible alternative or complementary supports for the user. For example, while human caregivers feature as human actors and stakeholders involved in this scenario they neither appear in the description nor during the actual experiments. This is another instance where the staging of robots for care rests on efforts to render the human care work invisible that enables and maintains the interconnection of people and technology in the first place (Puig de la Bellacasa 2011; Suchman 2007, pp. 217–220).

The users' role in this process is not simply to consume or imagine but also to actively immerse themselves in and act as part of the scenarios. In this sense, they take the role of actors who help to bring the staged reality of robots in care about. In the following transcript of one of the realistic tests, Henry, the interviewer, and the user, an elderly male, are in the living room and about to begin with the experiments, when the former gives instructions on how to go about the scenarios.

> "OK. Well, as I said, you will get different scenarios and situations and we would wish that you manage to immerse yourself in these different situations. After this, you have free choice in trying out these different services. I thought I start with reading the first scenario to you. This is a scenario for a phone call. Immerse yourself in the situation that you want to call a friend called Brian. Then you can call Robo to call Brian. Here you get the different scenarios (hands use cards over to test person). And then you can get started to interact freely with the robot." (Translated[93] video transcript, 16/08/15)

As a tool to realise this immersion process, the verbal instructions by the interviewer are flanked by so-called "Use Cases Cards" (experimental protocol, pp. 73-75), which are printed on paper and given to the user as a way to keep an overview of the possible services but also to guide the user's immersion process. Such cards contain descriptions similar to the scenario, but differ insofar as they directly target and activate the user:

> "Imagine you want to talk with a your (sic) friend or family member. Please use the robot to make a video call with your friends. Please active (sic) the communication service and perform a video call." (Experimental protocol, p. 73)

This excerpt shows that staging robots for care is not simply about teaching the user how to interact with robots but rather to render 'making use of a robot' plausible to them in the first place. This condition for realistic tests is not given but rather needs to be established by stimulating and activating users. Use cards and verbal instructions by the interviewer work as narrative devices, which should stimulate the user to assume their role as a *robot* user, to whom a robot is the only form of assistance ready-to-hand *vis-à-vis* particular problems of daily life. Narrative devices here become something of a technology of the self (Foucault 1988), in that it does not only trigger an already existing motivation but rather aims to *produce* elderly people as users of robots, who have to channel and *act on* their imagination making RobotCare a prototypical reality. In such a way they can become witnesses of something (Shapin 1988) that is not yet fully realised.

[93] Interviewer and test subjects mainly talked to each other in a North European language.

5.3.4. Distributed performances: failure and success in HRI

The actual interaction with robots falls far from that fictitious world of RobotCare depicted above. This is not only true for the pre-tests but also for the realistic tests. Instances abound, where users have to repeat their commands over and over again or where roboticists are forced to interrupt the experiment, which then results in often minute-long episodes, where the user simply waits. This means that the narrative stagings built up by the devices described above frequently break down during the experiments. In the following, I will cater to these narrative break-downs as a way to show, on one hand, how the techno-scientific drama of HRI 'fails' in front of the narrative backdrop built up above and, on other hand, how 'successful' HRI affords the situational interfacing of distributed performances, which often come into being precisely *despite* those alleged 'failures'.

As a way to show what I mean by narrative breakdowns, I take an example from the pre-tests, where a younger female user tests the 'scenario 1' described earlier. In that scenario the "[u]ser has the flu and (…) cannot leave his (sic) bed" (experimental protocol, p. 1). This and some other narrative assumptions are suspended in the following sequence to the surprise of the user.

"Not stuck in bed"

Field note (12/06/15)

The test person is directed to her chair. Henry, the interviewer, briefs her with regard to the upcoming test scenario. He holds the use case cards in his hand. "This is the scenario you are in right now." He shows her the scenario description on one of the cards. During the Skype service the test person wants to call her mum. For about a minute nothing happens. She repeats "my mum." Nothing happens. Henry turns to her: "I think the only name you can call is Brian." (in this moment the robot approaches them but stops about a meter in front of the chair." He prompts her to get up and pick up the tabled fastened to the side of the robot. The test person responds surprised: "Oh, so I'm not stuck in the bed" (as is prescribed by the scenario). "No, no", Karl says and chuckles. The user stands up, leans forward, unfastens the tablet and takes her chair again.

To begin with, this sequence shows the mundane reasons for which HRI and, consequently, the drama around it can break down. A 'false' name or one meter of distance can suffice to bring the performance to a halt. It also becomes clear that in these instances continuing the experiment at all stands above upholding the drama. Before, I have described the many ways in which roboticists, users, and a specifically adapted environment install a milieu, in which the robot can function, and in which the experiments can proceed at all. However, in this example it becomes clear that this comes at a price. The failure of the experiment is prevented only by the temporal suspension of the drama. Furthermore, these glitches and mishaps threaten the very narrative of assistive robotics as one of the roboticists frustratingly concedes during another test run: “How are we supposed to evaluate human-robot interaction when the robot does not interact?” (field note, 20/08/15). If the robot cannot interact, if the technology does not work, how is it supposed to deliver on its promise? As a result, roboticists aim to repair these situations *vis-à-vis* the users by revealing that doing robotics is difficult or conceding that the technology is just not there yet. Hence, this instance and similar ones also disclose something else: the deeply determinist assumptions that are built into the techno-scientific dramas of HRI. The above mentioned repairs entirely blame technology for failure and, consequently, see making better technology as the only vehicle to remedy failure. Ultimately, it makes HRI a problem of technology, not of interaction (for this, see also my discussion of the solutionist position in chapter 2.1).

In the following sequence, I will show that there are also (albeit seldom) examples of ‘successful’ HRI. ‘Success’ here does not simply mean that technology works but rather the spontaneous interfacing of a distributed performance. The following example relates to the situation I have described previously (see 5.3.1.), where the user, an elderly male, wants to be escorted out of the apartment but the robot goes to its home position. The following field note will describe the events in the living room as well as in the control room before that incidence. As a way to reproduce this simultaneity I have transcribed the events in two different columns. The names in the right column all allude to roboticists who are part of the project.

'Cool' HRI

Field note (16/08/15)

Living room	Control room
The user has just tested the communication service where he talked to one of the roboticists in the control room via Skype. The robot asks whether it can do something else for him. After the fourth "No!" the robot finally goes back to its home position.	From the main terminal, Philipp can already see that the next service will be the emergency service, where the robot warns the user of a 'gas leak'. Charles switches off the microphone, so the robot does not receive any further commands by the user. This could mix up the order of actions.
Then, suddenly, it returns. The user, seemingly confused, turns to the interviewer: "What does the robot want?" No answer. "This is a warning. Warning, there is a gas leak." The user, still confused, asks "What is happening right now?" The robot simply continues with its message: "You should leave the house as fast as possible!" It asks whether it should call the fire department, which the user affirms.	There is uncertainty whether the service has successfully been initiated. "Planning has failed" Philipp says looking at the main terminal's screen. Pierre attributes this to Philipp not having prepared the "parameters" for this test, which Philipp disclaims. "But he (sic) came to him" Pierre realises pointing at the camera stream on the screen in front of him. Charles starts to mock what is going on in the living room. This starts a series of jokes and laughter about how absurd the experimental situation is.
Then, the robot asks whether it can help with anything else; a standard phrase after each completed service. The user affirms: He wants to be escorted. The robot turns around and explains that the user can hold on to the handle and use buttons to drive it. The user does so and starts pressing the buttons but the robot does not move. For nearly a minute both stand next to each other without moving. Just, when the interviewer starts explaining that the service has probably failed, the robot starts moving suddenly with the user still holding on to the handle. "How can I make her (sic) stop" he asks. By letting the handle loose, the interviewer explains. That is when the user lets loose of the handle and runs back to his chair. "A technical failure" the interviewer concludes.	The user's choice of the escort service raises the attention of the roboticists. Among all the inconsistencies and absurdities of the scenario this is deemed to make sense, "because he wants to get out of there as soon as possible". This is "really cool", Philipp acknowledges. It does not take long until this contention is closed in by the realisation that the escort service does not work. The robot is not escorting the user but pulling him to the home position. This results in short controversy among people in the control room, when Philipp finally "kills the planner", that is, aborts the service.

Laughing and making jokes denotes a pervasive way among roboticists to react to failure or narrative breakdowns during experiments. In the above example, the fact that after informing the user about the gas leak, the robot simply continues by asking "Would you want me to help you with something else?" This is is deemed funny, because it breaks with what would be deemed plausible if a gas leak would have really occurred. Here, the scenario is suspended in favour of the experimental situation, where the robot is tested via a discontinuous collection of services.

However, in the above sequence the succession of tested services ‘makes sense’ nevertheless, that is, the user chooses a service, which according to the scenario is plausible in principle. This is deemed a success by the roboticists in the control room, because it denotes a “really cool” interaction. Success, here, does not mean that the robot works in a technical sense but rather that it allows for the spontaneous interfacing of a distributed performance. By choosing the escort service to leave the apartment (which is not possible), the user renders the discontinuous collection of services a plausible succession of actions. While he is confused by the robot’s actions in the beginning, he adapts his actions to the material-discursive propositions by the robot (warning of a gas leak, turning around to get a hold). In this particular instance, this (temporarily) works despite the fact that the robot does not actually complete the escort service and is driving ‘home’[94]. ‘Success’ also does not simply rely on the ‘creative’ initiative of the robot but rather relies on the interfacing of *distributed* performances: The silencing of the microphone by Charles, the communicative propositions offered by the robot, the presence of the interviewer and Philipp’s decision to let the interaction run even though the robot system reported a planning failure. The situation begins to fail only when all these performances fall apart, that is, when the experiment was aborted, the interviewer ‘explained’ the situation as a failure, and the user ran back to his seat as if he did something wrong.

This instance and similar others, albeit they seldom occurred, allow a glimpse at what successfully interfacing robots and people can look like and what conditions it affords. It relies on the situational co-adaptation of a whole milieu of distributed performances, both visible and invisible. Again, the prototypical does not allude to a fixed, isolated artefact, the assistive robot, but rather to a *prototypical milieu*, which is not fully realised but rather tentatively explored and probed *as-if* it was already realised. This clashes with and is even threatened by a determinist account of technological planning (Suchman 2007), which views HRI as simply a matter of getting technology right.

5.3.5. The technoscientific drama of human robot-interaction

The expectation for roboticists to demonstrate the plausibility, viability, and benevolence of robots in care, actuates a range of theatrical practices and performances, through which

[94] The robot’s home position is located in the corridor right in front of the apartment door. So, judging from the robot’s initial moving direction towards the door one could easily infer that the robot is actually escorting the user outside the apartment. This in turn could have contributed to stabilising the impression that everything works fine.

roboticists aim to stage robots for care. Here, robotics and elderly care are rendered available for one another in the course of technoscientific dramas that involve a range of interventions, stagings, narrative devices and distributed performances. By this, roboticists aim to interface the expectations of fast commercialisation, user needs, and epistemic claims about the autonomy of robots under the messy techno-material conditions imposed by the requirement for those tests to be 'realistic'. Here, staging realism is a way to keep out the wildness of everyday settings. The test apartment allows for a more or less controlled 'influx' or 'outflux' of messiness into HRI experiments. However, as we have seen in the previous section (5.2), such attempts to control messiness are themselves not immune to that messiness and regularly fail.

These stagings rely on invisibilising the conditions under which they are produced. This becomes apparent, on one hand, by the ways, through which roboticists try to conceal their interventions still indispensable to render 'autonomous' robots run-capable. Staging practices allow roboticists to control allegedly 'uncontrolled' conditions and, at the same time, invisibilise that control. On other hand, staging invisibilises alternatives and thus makes foregrounded interconnections more likely to seem plausible. This is exemplified by the way narrative devices stage robotics *vis-à-vis* a particular model of care and in particular (highly specific) situations. The solitary, 'independent' lifestyle and the 'home' of the elderly here serve as the background, in front of which robots in care can become plausible in the first place. The realistic tests strategically withdraw particular actors, such as human caregivers or other types of technologies, from the stage.

The investigation of staging practices also yields insights into the material-discursive milieu, in which these tests operate. Their conditions are highly situational and depend on a myriad of distributed elements, which need to be meticulously installed *vis-à-vis* each other. This especially applies to the *performance* of the experiments. Here, it becomes apparent that what is prototyped in these tests is not a particular robotic machine but rather its interconnection with a range of other elements. Despite (or because of) the roboticists' staging efforts these interconnections are extremely likely to fail. This 'failure' is linked to the very myth of autonomous robots as being free from help and self-sufficient. By contrast, the albeit seldom examples for 'sucessful' HRI show how such phenomena are highly dependent on the situational interfacing of distributed performances. In other words, the prototypical interfacing of robotics and elderly care fails under the very choreographies set out by those techno-scientific dramas.

5.4. Prototypical mode of interfacing

The starting point of this chapter was my enquiry into the robotics project at hand as a case for how European innovation politics aims to *prototypically interface* RobotCare and demonstrate its future potential. Therefore, the case study traced the material-discursive practices, by which robots and elderly people are rendered available for one another. The analysis identified two types of interfacing practices, *caring for robots* and *staging robots for care*. Here, the prototypical alludes to the double task of, on one hand, making integrated robot systems work with elderly users in messy environments and, on other hand, demonstrating that robots are viable and plausible solutions to problems of elderly care. In order to achieve this, robots need to prove themselves in the course of Human-Robot Interaction (HRI) experiments in specifically installed and prepared testbed environments supposed to emulate realistic conditions of elderly care.

These efforts proved to be extremely precarious. They were resisted not so much by (elderly) people but rather by various recalcitrant human and non-human surfaces, which became relevant throughout the experiments. While the promise of assistive robotics posits that interactive machines would take over domestic tasks for the elderly, the empirical analysis of the pre-tests suggests otherwise: rather than robots caring for people one can witness numerous instances where people must care for robots in order to make them work under the messy conditions of an assisted living apartment. Within the milieu of the test apartment, robots become the object of care. Such care involves an asymmetry (Puig de la Bellacasa 2011, p. 94), in which robots do not figure as universal tools to 'save' elderly care but rather as frail and needy beings that are dependent on a robot-friendly milieu. To install such a milieu is essential in order to make even the most trivial interconnections between robots and people possible. The vision of robots caring for the elderly becomes more far-fetched the closer one gets to its techno-material prototyping.

Nevertheless, roboticists are confronted with the expectation to align with those promissory discourses, that is, to demonstrate the plausibility, viability, and benevolence of robots in care. This provokes a range of theatrical practices and performances, through which roboticists aim to stage robots for care. Here, robotics and elderly care are rendered available for one another in the course of technoscientific dramas. These involve spatial arrangements that attempt to invisibilise the techno-material mess described above. The interventions by roboticists still needed to maintain human-robot interaction under such conditions need to be hidden backstage while the test apartment itself becomes the frontstage to a generalised representation of how elderly people are supposed to live with robots. This frontstage owes itself to the careful selection of elderly users as well as the meticulous arrangement of a 'home-like' ambiance. Furthermore, users' interaction with the robot are organised through narrative devices, such as, scenario descriptions or promotional videos. They are supposed to attach plausibility to the otherwise highly non-contextualised series of testing. These efforts to symbolically embed robots in care are counteracted by roboticists' technologically determinist planning assumptions. In their view, precarious demonstrations can only be remedied by 'better technology'. Contrary to this, I have shown that it is precisely this assumption that continues to threaten the distributed performances engendered in human-robot interaction experiments. As a result, these opposing logics of testing technology and demonstrating its use to care frequently clash with one another.

Hence, these results point to the material-discursive conditions of human-robot interaction 'in the making'. Here, it shows that it is not simply humans and robots that interact with one another as pre-existent entities. Rather, an analytics of interfacing renders visible the becoming and interplay of various (human and non-human) surfaces as well as the often mundane practices, through which roboticists seek to control recalcitrance and withdrawal of those surfaces *in situ*. As a result, such an analysis lays bare the paradoxical task of roboticists to, on one hand, somehow deal and learn from these unexpected complexities while at the same time staying aligned with and inscribing their research into the promissory discourse that has enabled them to fund such projects in the first place. I argue that this case exemplifies a particular mode, which allows roboticists (and, incidentally, all the other participants and contributors to those experiments) to navigate this paradox: a *prototypical mode of interfacing*.

First, the practices analysed above are charged with realising provisional, that is, temporarily stable and notoriously inchoate interconnections between assistive robotics and elderly care. While one could argue that the practical failure of such efforts denotes a threat for the overall narrative, the experimental nature makes such failures a valuable resource in practice. Milieus such as the test apartment and the tests operating in it create or rather configure unavailabilities as opportunities for ongoing 'debugging' and mutual adjustment of human and non-human participants in HRI. Thus, there is a productive momentum attached to this mess, the techno-material conditions of RobotCare. While roboticists see this mostly as a technical task, looking at what they are doing in actual practice reveals their deeds to be more than that – e.g. instructing users' voices or removing carpets. The outcome of such practices is not a stabilised robotic prototype but rather a number of interconnections between experimentally doing robotics, users' idiosyncratic ways of interacting with robots, and the very surroundings, where all this must be put into effect.

Second, these practices, especially those analysed in the second part of this chapter, allude to a particular visionary horizon, in front of which this techno-material tinkering can make sense (or not). Especially during the 'realistic' experiments the vision of RobotCare is not only prototyped in a material but also in a discursive sense. In aligning themselves, their robot designs, the elderly test users as well as the test apartment with that overall story of robots in care roboticists strive to actualise something that is 'not yet'. In other words, throughout these experiments participants act 'as if' RobotCare is already realised, completely plausible in and of itself. Such efforts are not mere window dressing but rather essential for understanding the discursive power of RobotCare. In staging and performing robots in care as a viable option to help the elderly such experiments do not simply present this vision but enact it. In other words, the prototypical milieu of the HRI experiments denotes a site where participants rehearse and act out those albeit inchoate interconnections between robots and people, robotics and care, a technology that is 'not yet' and a society which nevertheless acts 'as if'. In other words, it is through the encounters provoked in these experiments, no matter how ridiculous they might turn out, that society explores and probes prototypical ways of interfacing RobotCare.

6. Translating RobotCare

The previously analysed R&D project was largely concerned with exploring the future potential of robots in care. The emphasis lied on experimenting with robots in possible application scenarios while demonstrating their viability in care-like environments. This, however, does not mean that the European apparatus of innovation only seeks to prototype RobotCare. Even though (or rather because) robots still denote a rare exception in actual care practice, there is an unprecedented urgency attached to the task of *translating* robot prototypes into marketable products for elderly care. The case of this chapter, the CLARC project, promises to at least prepare such a translation: to develop a robot platform for automating the regular geriatric assessment in a Catalonian hospital.

The primary imperative of this project respectively its funding context is to tailor robot technology to the specific needs of that hospital in order to increase its chances for commercialisation on the healthcare market. To achieve this result, roboticists, end-users (doctors, health consultants, elderly people etc.) and the funders of the project need to constantly interact with one another. These interactions are governed by the so-called "Public End-User Driven Innovation" (PDTI) procedure, which signifies a particular EU funded pre-commercial procurement instrument. It requires a public body (here, especially a geriatric physician from the hospital[95]) to not only specify its requirements but also to monitor and if needed intervene into the development process. Roboticists are thus expected to adjust or expand the functionalities and specification of their design *vis-à-vis* the feedback from the public end-user. Ultimately, the project's funder[96], the 'European Coordination Hub for Open Robotics Development' (ECHORD++), expects the resulting technological solution to satisfy the hospital's requirements to the point that it invests further in its development (e.g. in the sense of a Public Procurement of Innovation[97] scheme). This procedure is hoped to open up

[95] In fact, the 'end-user' in this case is not represented by a singular person but rather comprises a whole array of actors. For example, while the hospital indeed might become the customer that acquires the robot in the end, the developers mostly interact with and are monitored by a geriatrician and other health professionals.

[96] ECHORD++ is itself a project funded by the European Union. The fact that an EU funded project funds other projects like CLARC indicates a particular scheme called 'cascade funding', where funds initially tendered by the EU are redistributed by ECHORD++ via its own open calls. One of such calls was the PDTI on healthcare, through which the CLARC project is funded.

[97] While the PDTI can largely be subsumed under the category of so-called Pre-Commercial Procurement (PCP), which only prepares an eventual commercialisation of a given technology, a Public Procurement of Innovation (PPI) scheme would endeavour to actually bring an innovation to market. In such a procedure, the public body would actually promise to buy a given technology, if certain requirements are met.

further opportunities for the CLARC consortium in particular but also for the robotics community in general to bring robot technology (at least closer) to a marketable stage.

Hence, this chapter will investigate the CLARC case as another milieu in which robotics and (geriatric) care are interfaced. I will unfold this argument in six steps. First, I will introduce the case of CLARC and its organisational as well as political context, namely, the ECHORD++ framework and the PDTI procedure (6.1.1.). The heuristic starting point of this chapter is to take the PDTI procedure as an interessement device aiming to reconfigure a whole milieu of elements, such as the users, their needs, the robot and the roboticists themselves, into a favourable terrain for the translation of robot technology into marketable products for geriatric care (6.1.2.). Second, I begin my analysis by showing that the PDTI procedure requires the involved public bodies to be interested as prospective users, who are ready to initiate innovation processes and consequently problematise their professional domain *vis-à-vis* the potential of robot technology (6.2.). Third, such users are involved in producing the very need that robotics is then set out to satisfy. However, this does not mean that robotics simply solves a given problem. Rather, that need is reworked through by a number of practices, which interface what geriatrics might need and what robotics can actually do (6.3.). Fourth, throughout its development, the CLARC consortium is constantly confronted with conflicting requirements from different user groups with regard to what a robot should do. Especially controversies around the robot's interactivity and affordability, different accounts of what makes a robot clash (6.4.). Fifth, the PDTI sees the commercialisation of robot technology to hinge on entrepreneurial faculty and personality. However, roboticists see themselves mainly as researchers. As a way to counteract this, the PDTI materialises a monitoring and governance regime, which requires roboticists to conform to entrepreneurial criteria for success instead of scientific ones (6.5.). Sixth, taking all these different practices together renders visible the scope of a translational mode of interfacing, which is oriented towards interesting a broad range of human and non-human actors as allies of commercialising RobotCare (6.6.).

6.1. Pre-commercial procurement 'in the making'

The research object of this chapter is an EU-funded pre-commercial procurement project, which aims to develop and implement a robotic platform for automating the geriatric assessment in a Catalonian hospital. This project is confronted with the expectation to adapt the robot design to the requirements of a public end-user from the very beginning of the project. The hope is that through this adaptive process, the public body will be enough interested in the robot prototype to further invest in its development and marketisation.

6.1.1. *Case introduction: CLARC and its context*

This chapter's analysis centres on the R&D project 'CLARC', which is funded under an open call from ECHORD++, the 'European Coordination Hub for Open Robotics Development'. In this call, the challenge is to develop an assistive robot platform for automating the so-called 'Comprehensive Geriatric Assessment' (CGA) procedure in a Catalonian hospital. CGA comprises around a dozen different standardised geriatric tests, which evaluate the socio-medical living condition of elderly people according to particular parameters, e.g. their ability to walk or possible indications of depression. For each patient, the procedure is conducted periodically every six months and involves face-to-face interviews with the elderly as well as their caregivers (be they professional or relatives). The quantitative results are then analysed by geriatric physicians, nurses and physiotherapists, who, on this basis, devise an individualised care plan for each patient. In this context, the CLARC project aims to develop

> "a mobile robot able to receive the patient and his family, accompany them to the medical consulting room and, once they are there, help the physician to capture and manage their data during the Comprehensive Geriatric Assessment (CGA) procedures." (ECHORD++ 2018a)

The hope is that the robot would overtake most part of testing and thus allow healthcare professionals to spend more time on the analysis of the results and individual care plans.

ECHORD++, the funder of this project, comprises over thirty projects in different funding categories. ECHORD++ generally subscribes to the mission to bring robotics "from lab to market" by enhancing the interaction between robot manufacturers, researchers, and users (ECHORD++ 2018b). ECHORD++ was funded by the European Commission from 2013 until 2018 under the 7th Framework Programme. It denotes the successor to ECHORD, the 'European Clearing House for Open Robotics Development', which ran from 2009 to 2013. Both of these projects operate via a so-called cascade funding scheme. This particular form of funding means that ECHORD++ applies for funds from the European Commission, which it then redistributes and tenders across different funding instruments through open calls of its own. Within ECHORD++, there are three of such funding instruments: 'Experiments', 'Robotics Innovation Facilities (RIF), and 'Public End-User Driven Technological Innovation' (PDTI).

The CLARC project is funded within the latter category. PDTI operates as follows: ECHORD++ calls for proposals by public bodies setting out a potential application scenario for robotics in their respective domain. In our case, that domain was pre-set as the 'healthcare sector'. This procedure of finding an application scenario denotes itself a competitive process, where an expert board commissioned by ECHORD++ evaluates and selects from the range of proposals submitted by public bodies. In the case of the healthcare PDTI, they picked the challenge of a hospital from Catalonia to automate the CGA described above. This challenge is then translated into an open call, for which robotics consortia (consisting of both industry and academia) are then picked to develop a robotic solution. This foregoing competitive procedure of creating a challenge denotes the main difference of the PDTI *vis-à-vis* existing schemes of Pre-Commercial Procurement (PCP). PCPs in general should allow public bodies to kick-off promising innovative technologies or services, from which they expect a benefit that is not yet attainable with solutions available on the market.

Hence, in this context public bodies do not simply play the role of the customer procuring a more or less finished product but rather act as facilitators of and stakeholders in innovation processes. At the same time, innovation policy attaches tremendous hope to PCP and public procurement in general, since they expect the immense spending power of the public sector to be a big factor in fostering innovation in Europe (European Commission 2010b, p. 16). Here, the lack of innovative public procurement and its strategic use is positioned as a major factor for the perception of "Europe's lack of innovation-driven market development" (European Commission 2014a, p. 35). The ECHORD++ project is strongly embedded within this policy context and positions itself as a vehicle to re-orient public procurement in Europe to and act as a model of values more compatible with the requirements of procuring (pre-commercial) innovation (Interview 1 ECHORD++, 09/06/17). In this context, the main objective of the PDTI respectively ECHORD++ is to probe and establish standardised procedures to accommodate more interactive and 'open' models of innovation (European Commission 2014a).

Analysing this case mostly relies on six interviews I conducted with members of the CLARC consortium, the Catalonian hospital, the 'Agency for Health Quality and Assessment of Catalonia' (AQuAS), which was also involved in the project, as well as with members of the ECHORD++ consortium. Additionally, I can resort to a number of documents produced in the course of the PDTI process and beyond. For example, I have obtained the original proposal by the geriatric physician, which lead to the PDTI call on healthcare. Most of the other documents are publicly available and comprise publications of ECHORD++ as well as the CLARC consortium. Finally, the analysis draws on field observations during a field testing event in October 2018 that was held in the Catalonian hospital mentioned above.

6.1.2. The PDTI as interessement device

In analysing the phenomenon of the PDTI in general and its realisation within the CLARC project in particular I can build on a longstanding discussion of innovation as socio-technical phenomenon in STS (Bijker et al. 1987; Bijker and Law 1992). Here, I will especially draw on attempts of actor-network theory (ANT) to theorise "innovation in the making" (Akrich et al. 2002a, 2002b). Similar to those authors, the present study investigates the commercialisation of robot technology not as depending on characteristics inherent to that technology (e.g. its functionality or cost). Rather, it looks at it as a contingent, open-ended process, in which technology and the social environment that adopts it need to be continuously adapted to one another. Such a perspective assumes that

> "…any innovation presupposes an environment which is favourable towards it. If it does not exist, there is no point in talking about attractive costs: productivity and profitability are the results of a persistent action which aims to create a situation in which the new technology or product will be able to create value out of their presumed qualities." (Akrich et al. 2002a, pp. 195–196)

However, the following case study is not interested in the eventual (non-)adoption of a robot in a Catalonian hospital (this is also not what is ultimately at stake in this project). Rather, I will take this starting point to orient my analysis of interfacing RobotCare. In other words, the PDTI respectively the CLARC project denote particular instances, in which robotics and (geriatric) care are rendered available for one another. Hence, I am interested in the kinds of interconnections that are necessary for the various participants to even start working in the direction of commercialising robots in geriatric care – including the kinds of resistances and withdrawals that might bring this endeavour to a halt. For this analytical agenda, the socio-technical analysis of innovation proposed by Akrich and colleagues provide a productive heuristic focus on processes of *interessement*.

Most generally defined, interessement "is the group of actions by which an entity … attempts to impose and stabilize the identity of the other actors it defines through its problematization" (Callon 1986, pp. 207–208). In our case, it denotes the kind of work by which certain actors attempt to render other actors compatible *vis-à-vis* a particular innovation respectively a whole innovation process. For instance, the PDTI problematises[98] public bodies to become prospective users of robot technology, it tries to impose robotics state of do-ability onto what those bodies

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[98] Akrich et al. conceive problematisation as the process by which actors aim to re-channel each others' identity and action. In contrast, Foucault understands it as a more general (discursive) process, by which certain (political) problems and solutions become produced and connected. I take these two accounts not as identical but as compatible. Incorporating both conceptions allows for a scalable and attenuated analysis of how interfacing practices are operating on material and discursive levels. For example, the coaching of roboticists on business planning (see section 6.6.) can thus be described as connected to the overall imperative in European innovation policy discourse to "make Europe more enterprising", see European Commission 2014a, p. 67. This simultaneous use of the term problematisation thus conforms to the general orientation of this study to grasp the "mutual entailment" of material and discursive practices, see Barad 2003, p. 820.

propose as their specific needs. Consequently, the proposed prototypes become target of continuous problematisation *vis-à-vis* those different expectations. Finally, the PDTI aims to stabilise an entrepreneurial subjectivity in roboticists through workshops and the overall project governance.

Such problematisations do not operate unopposed but rather are confronted with resistances and withdrawals from those actors. In other words, interfacing in this context means to deal with the problem that actors are "defined in other competitive ways. (…) To interest other actors is to build devices which can be placed between them and all other entities who want to define their identities otherwise" (Callon 1986, p. 208). Hence, the PDTI denotes a particular device, through which ECHORD++ (and, with it, the European Commission) aim to interface all the actors listed above via a particular procedure of public procurement. Through the lens of 'interessement', interfacings are thus conceivable as attempts to stabilise those actors as compatible components of a translational milieu oriented towards the commercialisation of robot technology in (geriatric) care.

6.2. Prospective users

The 'Public End-User Driven Innovation' (PDTI) instrument promises to include public authorities in the development process of robot technology from early on and by doing so have direct 'access' to their needs. It does that in an unusual way. Users participate not simply as test subjects of given application scenarios as in the case of the previously analysed R&D project. Instead, their participation already starts in the so-called 'phase 0', where they propose particular use cases to the ECHORD++ consortium, which then selects one 'challenge' and invites robotics consortia to apply to an open call (I will draw more closely on the actual creation of the challenge in the next section). Empirically, this preparatory procedure is confronted with the problem that (a) such users are hard to find and (b) that there is no pre-existing need for robotics in the beginning. This means that ECHORD++ not simply 'finds' users and 'accesses' their needs but rather must invest considerable effort in rendering them *prospective users* that come up with new needs and, hence, with new problems for robotics to work on. Here, becoming a prospective user does not simply mean to be targeted as a 'potential' customer but rather to *actively prospect* possibilities to innovate a given work environment and practice, which in our case is the Comprehensive Geriatric Assessment (CGA) procedure. This figure relates to existing discussions on the altered role of "prosumers" (Toffler 1989) or "innosumers" (Peine et al. 2014) in the context of digital modes of production (Ritzer and Jurgenson 2010; Grinnell 2009). I will come back to this lineage at the end of this section.

6.2.1. Interesting public end-users

The PDTI process promises "to make sure that the product meets the requirements of the target group, technically and price-wise" (ECHORD++ 2018c). The first herein contained assumption is that there *is* a public end-user, who has a problem solvable with robotics. To ensure this, the PDTI seeks to base the development process on "public demand knowledge" (Puig-Pey et al. 2017, p. 167), i.e. knowledge about what a given public body needs and what the specific (technical, financial, legal etc.) requirements for fulfilling that need are. This happens in the so-called 'phase 0', where public authorities (e.g. a hospital or a municipality) can submit proposals for a 'challenge for healthcare'. However, in the particular case of the PDTI on healthcare, it proved to be difficult to find public bodies interested in robotics respectively the PDTI.

> "Well, the first thing that was necessary was that we have explained to public institutions …, what is robotics and what benefit can they generate via robotics. Well, we had a relatively long forerun, where we have started completely from scratch to contact public institutions, which were nowhere present and which we had to identify in a painstaking effort. It was like 'cold selling', you know? Making phone calls, well, cold calling in principle. So and then to explain to people, what is robotics, what do we want to achieve with this call and so on and so forth."
> (Interview 1 ECHORD++, 09/06/16, my translation)

This quote shows that the first challenge seems to be to interest public bodies in taking part in the creation of a 'challenge for healthcare'. To the surprise of the ECHORD++ coordinators, it was hard to get a hold of those authorities. Here, it proved particularly difficult to find people within public institutions that were responsible for or open to robotics respectively the PDTI process. The interviewees within the ECHORD++ consortium described this as an extremely laborious task. For this, it did not suffice to rely on established channels of social media or public relations. It afforded 'cold calling' and "a lot of very expensive communication" (ibid.).

The conditions for successfully establishing contact with public bodies lied in the ECHORD++'s personal network. The way in which the eventual challenge was 'found' illustrates this nicely: It came from the geriatric unit of a Catalonian hospital respectively from a physician in its geriatric unit. ECHORD's call for proposals only reached him, because of pre-existing contacts[99] between one of ECHORD++'s partners, the Universitat Politècnica de Catalunya (UPC), and the 'Agency for Health Quality and Assessment of Catalonia' (AQuAS),

[99] This case is representative of many consortia and partners involved in ECHORD projects, who were mostly recruited from an already existing personal network (Interview 2 ECHORD++, 09/06/16).

which disposes over a great network of healthcare providers in the Catalonian region. AQuAS has longstanding expertise in setting up and managing innovation and public procurement projects in the Catalonian region. They assisted the hospital in question in writing the proposal (I will draw on that in more detail later, see section 6.3.). For them, 'success' meant that one of the two proposals they supported was accepted by ECHORD++ (Interview 1 AQuAS, 08/02/18). So, AQuAS was more than simply a supplier of contacts in the region. It rather served as an infrastructure for interfacing potential users and robotics, which eventually allowed the PDTI to commence operations.

This shows that indeed users are not simply there but rather it affords laborious, painstaking preparations and interessement in order to render them favourable *vis-à-vis* ECHORD's undertaking – and *vice versa*. Here, it is important to note that end-users did not simply join the project as such but rather had to be problematised as. a particular kind of user: *prospective users*. They were required to assume risks as facilitators of innovation and to problematise the *status quo* of their professional practice (here: the CGA) in light of ostensible potentials of robotics technology.

6.2.2. Public end-users as facilitators of innovation

The first point refers to a shift in the logic of public procurement effected by the PDTI and its focus on the procurement of innovation. While public institutions usually seek to procure existing products on the market, the PDTI refers to the acquisition of products and services that are not yet available on the market. That is why this branch of procurement instruments is also called 'Pre-Commercial Procurement' (PCP). This affords a higher readiness to assume risk on the part of public bodies.

> „In other words, you need an entirely different approach. You do not procure 'best value for money', but you take part in generating a product, which optimally satisfies your needs. That is a considerable mind shift, which is especially absent in public procurement in Germany. (…) And another problem is that we punish failure in Germany. (…) If you buy 'best value for money', the risk of failure is low. If you invest into innovative procurement, then the risk of failure is relatively high." (Interview 1 ECHORD++, 09/06/17, my translation)

Hence, public bodies here do not simply act as consumers but as investors of innovation. They do not simply acquire a given product with some re-specifications but they invest in something for future returns while assuming the risk that those returns fail to materialise. Here, it is important to note that in the case of the PDTI (as in PCP in general) the public end-user does not directly finance the development. On the contrary, the hospital becomes part of the PDTI consortium and even gets funding for expenses. It only gets 70% reimbursed, which is similar to how companies are treated in European projects. Still, the hospital invests working hours of its personnel (especially of the doctor who is responsible for the scenario), it provides expertise and its premises for piloting the robot prototypes. Compared to this, the hospital assumes the risk that the developed products might either not be completely finished let alone certified[100] for application in care practice. So while the big promise of ECHORD++ and the PDTI revolves around the transfer of robot technology "from lab to market" (ECHORD++ 2018b), it becomes clear that actual practice and methodology of the PDTI is much more modest. It is mainly about preparing rather than completing the translation of robot technology into a full-fledged product for healthcare. An important aspect of such preparations is to find and interest prospective public users willing to assume risks of failure and continue their investment after the small-scale test series scheduled at the end of the PDTI. This means for public authorities to move away from simply calculating 'best value for money' and towards seeing themselves as facilitators and investors of innovation.

6.2.3. Rendering geriatric care roboticisable

The second way of how the PDTI aims to turn public authorities into prospective users relates to the relation they should assume *vis-à-vis* the status quo of their professional practice. In the present case, this mostly involves the aforementioned geriatric physician who, together with the AQuAS organisation, submitted the initial idea of what later became the challenge for the PDTI on healthcare. Here, the physician is not only imagined as the potential end-user but rather as a prospective user, who can speak for geriatric care and who can think of problems representative of the whole healthcare market. In theory, this is assumed to be unproblematic since the narrative of ECHORD in particular and European innovation policy in general assumes that there is a "future European need" for robotics (Partnership for Robotics in Europe 2013, p. 13). In other words, the basic assumption of PDTI is that there are not only users but that those users already hold real-world problems solvable with robotics that merely need to be accessed by way of asking those users. In practice however, this is not the case. Such problems first need to be produced, that is, users are required and need to be incited to problematise their professional practice in light of what robotics has to offer. However, this runs into the problem that users simply do not know (enough) about robotics.

> "We have tried to get from them a so-called Challenge: So to say, 'What problem do you have, which we could solve with robots?' And, that was super difficult, because they have not the least

[100] For example, out of the nearly dozen different tests, of which the CGA consists, only two were ready for testing at the beginning of the final phase of the PDTI.

> idea, what is even feasible robotically, what is possible technically. And then they maybe do not know the institutions and do not know what they can gain from it. And the funding instrument was also completely new of course. So to even excite people to say 'OK, I will think about where we can need a robot here.'" (Interview 2 ECHORD++, 09/06/17, my translation)

In this quote, it becomes evident that, in practice, it is not self-evident that users need robots. For robotics to come close to the political claims about their "potential to transform lives and work practices" (Partnership for Robotics in Europe 2013, p. 3) it needs to excite prospective users. This proves to be very difficult, mainly because public bodies do not know (enough) about what is feasible in robotics. This is a pervasive concern of interviewees who are part of the ECHORD++ consortium (for example in interview 2 ECHORD++, 09/06/17). As a result, the aforementioned practices of cold calling are flanked by workshops, info-days and other events that should educate possibly interested public bodies about the opportunities that robotics has to offer. Here, the problem not only relates to users' 'lack' of knowledge but also their supposedly 'wrong' ideas about robotics. In healthcare, for example, ECHORD++ interviewees report that the public bodies actually *did* know about robotics. However, they either did not know what robotics could do for them in their daily work practice or they thought that robots should not be used in healthcare for ethical reasons (interview 2 ECHORD++, 09/06/17). So, instead of simply accessing problems, ECHORD++ has to incite, inspire, and appease public bodies about applying robotics to their field. In other words, in its effort to interface public end-users and robotics ECHORD++ is confronted and must deal with resistances and withdrawals on the former's side. Since there are no pre-figured problems ready to address, ECHORD++ must create and channel that readiness in end-users to *problematise* their work practice in accordance with what robotics has on offer.

This again relies on a range of interfacing practices. One of them is a questionnaire, which was circulated within the aforementioned ECHORD++ network including the Catalonian hospital concerned here. The questions herein contained ask the prospective user to describe and flesh out "a challenge that robotic solutions could solve in 5-10 years" (Geriatrician's initial proposal, p. 1). Additionally, this questionnaire enquires about the state of the art in the prospective user's field (e.g. how the CGA is currently conducted), the expected user needs, the required technical infrastructure, the specific national requirements, other technological solutions on the market as well as the scope of the challenge within the concerned field. I will go back later to this questionnaire and to the process through which it was produced.

For now, I will focus on how the geriatric physician stages the usefulness of a potential robot in his daily work routine. On the one hand, this denotes another instance where robotics and geriatric care are rendered available for one another. On the other hand, it gives insight into what it means to act as a prospective user in this regard.

> "Geriatric patients usually need to perform or accomplish several clinical tests included in the comprehensive geriatric assessment (CGA). CGA is the most useful clinical tool which is used by all health professionals involved in the medical and social care process focused on older people. (…) It would be very useful if CGA can be carried on by some robotic solution. (…) The main objective is not to replace human professionals but enable them to have more time to be spent for care planning decisions itself (the analytic and comprehensive final step of CGA) instead to spend very valuable time for just 'doing tests'." (Geriatrician's initial proposal, p. 1)

In his answers to the questionnaire, the physician testifies the usefulness of a robot in geriatric care by demarcating part of it as roboticisable and otherwise problematic. He draws a distinction between areas in which robotics is permitted to intervene (e.g. standardised testing), and areas, which should be left to humans (e.g. care planning, analysis). A robotic solution should not threaten the supposedly 'comprehensive' task of human professionals but should rather be instrumental in freeing up temporal resources for them. The regained time could then be spent on more important or valuable activities, such as care planning decisions. This distinction rests on assumptions about the value of different tasks in geriatric care. Here, merely 'doing tests' is considered to be a tedious task due to "the repetitive/mechanistic and tiring nature of some standardized medical test like questionnaires" (Email geriatrician, 11/12/17). This questionnaire materialises existing hierarchies between medical and assistive labour in healthcare (Bose and Treusch 2013, p. 258). The specific drive of the questionnaire also stimulates the geriatric physician in staging the usefulness of robotics for geriatrics and, at the same time, re-interpreting geriatric care practice *vis-à-vis* robot technology. For example, the questionnaire invites a logic of time and cost efficiency (having 'more time') into the practice of geriatric care. Hence, part of the reasons why the geriatric physician 'finds' the CGA tiring can be attributed to the ostensive availability (or persistent offering) of robot technology. This, too, rests on particular configurations of what makes a machine ('mechanistic') and what makes humans ('analytic', 'comprehensive').

A prospective user thus is incited to demarcate potential areas available for mechanisation by robots through attributing to them certain characteristics (dispensable vs. necessary, repetitive vs. comprehensive, robotic vs. human etc.). Interfacing takes the form of assuming and making the doctor speak as a representative of geriatric care practice uttering the truth about its (partial) roboticisability as well as the utility of care as an application area for robotics. Similar to what Foucault has described with regard to pastoral power (Foucault 1982) the interfacing takes the shape of a confession, where the doctor's answers are taken as a testimony to the needs of care and the usefulness of robotics in regard to those needs. However, as we will see later, the doctor is by far not the only user of the robot. Elderly people, other health professionals and the hospital's administration might bring other testimonies of needs to the table. Hence, the questionnaire in particular and the PDTI procedure in general produce the geriatric doctor as "spokesperson" for geriatric care (Akrich et al. 2002b). The PDTI thus becomes visible as an interessement device, which activates some users while invisibilising others.

While there is indeed a lot of hope attached to a shifting understanding of the (elderly) user respectively consumer as actively involved in innovation (Peine et al. 2014), it is instructive to see how these subject positions are interfaced within such processes, i.e. what other concerns they are rendered available for. This becomes visible in the following section, where the initial ideas of prospective users need to be continuously adapted and thus reconfigured in regard to what robotics can actually deliver.

6.3. Doable needs

With the PDTI instrument, ECHORD++ claims to be able to offer public bodies tailor-made technology to the point that it meets their "specific requirements" (ECHORD++ 2018c). As we have seen in the previous section, public bodies do not simply have those requirements *a priori* but they need to be produced and brought out through a range of networking and confessionary techniques. However, this does not mean that the kinds of problematisations of the doctor mentioned before are simply adopted as template for the development of robot solutions. Instead, that initial proposal and the herein contained needs denotes merely the first in a series of versions, which are interfaced throughout a long and laborious process. This procedure involves not only the public body but also the aforementioned Catalonian healthy agency (AQuAS), the ECHORD++ consortium, and a board of (robotics) experts commissioned by the latter. The following section will trace this process and how it interfaces the so-called "Challenge for Healthcare" (see figure 20) as well as the eventual challenge brief, which defines the technical requirements for robot developers. Only the latter allows robotics consortia to apply for this challenge through an open call. So instead of simply matching robot technology with a given, immutable need, a number of different concerns and requirements (plural!) need to be interfaced, that is, mutually adapted and reconfigured. I call the product of this procedure *do-able needs*[101], in which what healthcare might need and robotics may be able to do is rendered compatible with one another.

6.3.1. *A 'challenge for healthcare'*

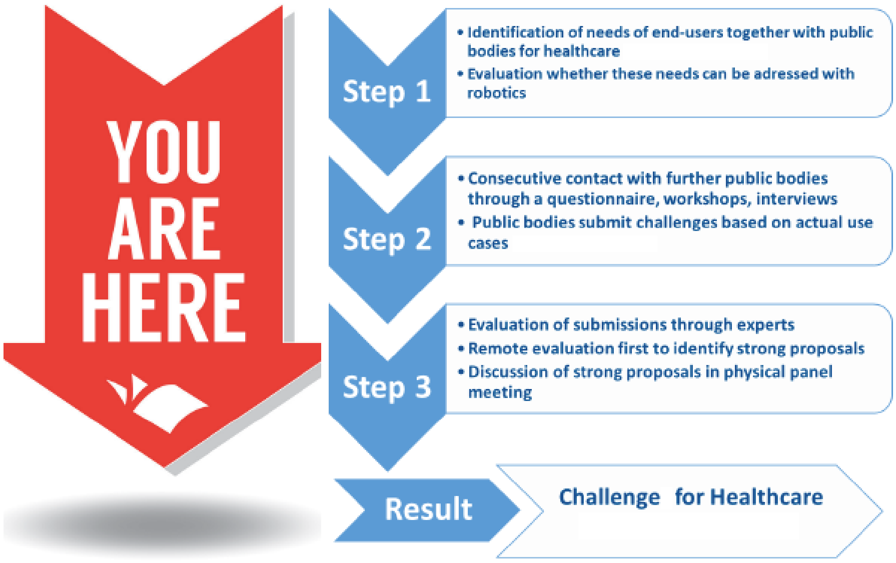

Figure 20 ECHORD++ 'Challenge for healthcare' (ECHORD++ 2016, p. 4)

In the previous section, it was made clear that the 'identification' of public bodies and their needs rest on extensive interfacing practices. These intensify when it comes to creating the 'challenge for healthcare' as shown in the figure above (see step 2 and 3 in figure 20). At the heart of this process lies the interfacing of expectations *vis-à-vis* what robotics can and cannot do. Here, interviewees from the ECHORD++ consortium problematise 'unrealistic' images of robots on the part of public bodies[102], that is, of what robotics can *'really'* do. This becomes clear in the following quote, where one of the ECHORD++ interviewees talks about a meeting with representatives from the Catalonian hospital:

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[101] This notion of 'do-ability' is inspired by Fujimura's ethnographic study of how scientists in cancer research construct do-able problems by articulating alignments between different levels of work organisation, see Fujimura 1987. While adopting the notion of do-ability as the product of alignment (i.e. interfacing) work the following section will not include different levels of work organisation but rather different groups of actors on a single level, the creation of a 'challenge for healthcare'.

[102] The following 'problems' interviewees describe seem to be specific to the PDTI on healthcare. Parallel to that ECHORD++ conducted another PDTI on sewer inspection also in Catalonia. There the problem was not so much that they had 'wrong' ideas about robotics but that they were completely unaware of robotics at least with regard to their professional field. In the case of the PDTI on healthcare, officials were more aware of robotics due to the media presence of the topic. However, here the problem lied more in their wariness to see robots as an ethically sound solution in their field. This is simply to say that the following discussion seems to be very specific to the case of health respectively elderly care.

> „The image of robots is super strongly shaped by everything that is Science Fiction. And in Science Fiction robots can mostly do anything. Either they can subjugate the world or they can cause the world to turn for the better. But it has relatively little to do with real robotics. And we have realised that of course, that they had a entirely different image of robots in their heads compared to what is reflected now in reality. So if I want to be mean, then those PDTI robots, which are in development now, they are iPads on wheels. (…) And that is of course poles apart from saying 'OK, a robot can do something like drawing blood. Well, those are two completely different worlds technically." (Interview 2 ECHORD++, 09/10/17, my translation)

In this quote, it becomes apparent that the aforementioned prior knowledge by health practitioners about robotics becomes a problem. This is not only because they may be wary to use them for ethical reasons but also because this knowledge is deemed to be misinformed by an unrealistic image of what robots can actually do. According to the interviewee, science fiction paints a picture of robotics as omnipotent either in an extremely bad or good way. While in the beginning of the PDTI procedure this prior knowledge could be used as a resource to interest prospective users in re-thinking their professional practice *vis-à-vis* the 'benefits' of robotics, it now is seen as inhibiting the creation of a challenge that robotics can actually deliver on.

What is presented here as a pre-existent 'knowledge gap' constitutes the need for the ECHORD++ consortium to introduce their own knowledge reflecting the supposed 'reality' of robotics. Based on the 'gap' between these "two completely different worlds" (ibid.) the ECHORD++ consortium organises workshops and info-days (interview 1 and 2 ECHORD++, 09/06/17), which aim to interface what might be beneficial for healthcare and what might be do-able for robotics. On the one hand, this involves disappointing images of robotics inspired by Science Fiction. What robotics has on offer does not go beyond "iPads on wheels" (Interview 2 ECHORD++, 09/06/17, my translation), as the interviewee from above puts it. On the other hand, the confrontation with practical requirements from geriatrics is also to stimulate prospective users and members of ECHORD++ to go beyond the state of the art. During such events, prospective users but also experts from ECHORD++ should together develop challenges that robotics could actually solve "in 5-10 years" (Geriatrician's initial proposal, p. 1). In other words, the eventual challenge should settle down within a particular corridor of do-ability, from which far-off sci-fi visions as well as already available technology must be excluded.

6.3.2. *Judging 'adequate' proposals*

This process of interfacing what geriatrics might need and what robotics might be able to do continues and diversifies in the selection of the proposals that were submitted by public bodies. The judgement of the "adequacy" of proposals (Interview 1 ECHORD++, 09/06/17, my translation) is done by an external review board commissioned by ECHORD++. Here, adequacy is the product of an evaluative practice where a number of different concerns, beyond mere do-abiliy, need to be weighed up against each other, rated, and ranked.

> „The assessment was made by external reviewers. Well, they have really looked at the list [of proposals; B.L.] and they did know both worlds. Well, they simply knew what is going on in healthcare but they also had an idea about robotics. And they have brought that together…, had made an assessment between, 'OK, that is the challenge. Is that even technically possible? Can one do that? Is that even a good idea? Is there a market potential for it?'" (Interview 2 ECHORD++, 09/06/17, my translation)

This quote shows how judging the "adequacy" of the proposals (Interview 1 ECHORD++, 09/06/17, my translation) depends on 'bringing together' a range of different concerns and their translation into a weighed evaluation. Next to the concerns already mentioned, the above quote mentions the marketability of the envisioned challenge as an additional criterion according to which the proposals are evaluated. This potential explicitly goes beyond the need of the single public body with which the challenge as well as the robot solution are eventually developed. Here, the experts evaluate the scalability of a given challenge, that is, its prevalence in a given market (for example, geriatric assessments).

This is not only judged by the experts alone but also something that needs to be contained in the initial proposals. Here, prospective users testify the scope of a given practice or problem in a given field (e.g. whether this is something specific for that hospital or a general issue in geriatrics). However, prospective users do not do this on their own but, at least in the case of the Catalonian hospital, they are assisted by the aforementioned health agency AQuAS. An 'adequate' healthcare challenge needs to satisfy a range of different requirements that explicitly go beyond the "specific requirements" (ECHORD++ 2018c) of the single public end-user implicated in the PDTI. Here, AQuAS played a crucial role in interfacing so-called 'functional' and 'technical' requirements for a robot solution.

> "In AQUAS we are technical and consultants and project managers. … I particularly have a strong expertise in ICT. … I don't have the knowledge of a … geriatric practitioner. But I have the technical knowledge to help them to put the health requirements into requirements that could be fulfilled technical team, you know? That is my expertise. As AQUAS we give them advice

> and we help them to define and to decide and to make proposals in this sense. The personal knowledge and the contact with the elders was from the geriatric practitioner. But the one that converted or translated this knowledge and the needs for this project was AQUAS, was me in this case who did that." (Interview 2 AQuAS, 12/02/18)

So, in the process of drafting the proposal, the 'functional' aspects of the potential robotic technology stood out. I have already described them in the previous section: The main hope of the doctor (and incidentally of AQuAS) was to save time for 'more valuable' tasks in the geriatric assessment of elderly people. However, these functional requirements have to be translated into technical requirements 'that could be fulfilled by a technical team'. From the very start, the 'healthcare challenge' was drafted in light of such technical questions. For example, ECHORD++ wanted to know what kind of technical infrastructures would be necessary for the installation of a robotic solution.

Furthermore, the application scenario the doctor came up with had to "[d]escribe a challenge that robotic solutions could solve *in 5-10 years*" (Geriatrician's initial proposal, p. 1, my emphasis). A proposal of a healthcare challenge for robotics needs to open up the opportunity for robotics to "go beyond the state of the art" (Interview 2 AQuAS, 12/02/18). AQuAS takes an important middle position here, by translating those health requirements into technical ones. This afforded "a strong expertise in ICT" (ibid.). As a result, the doctor was asked to sketch out other "current technologies that solve the described challenge or parts of it" (Geriatrician's initial proposal, p. 1). The doctor's proposal points to an existing software solution, which however cannot tackle the functional tests that evaluates the gait and balance of elderly people (Geriatrician's initial proposal, p. 2). Here, the expertise of AQuAS was needed again to identify potential competitors in this market. An important precondition for a challenge to be compatible with the ECHORD's PDTI instrument is that existing "solutions are not complete" (Interview 2 AQuAS, 12/02/18). So, from the start, the healthcare challenge was developed in light of what robots (and other technologies) can do as well as what they could do when applied to the CGA procedure. Hence, a 'good' proposal does not simply represent what healthcare needs, it rather denotes a first instance where what healthcare supposedly needs must be interfaced with what robotics can offer (compared to other technologies).

6.3.3. The challenge brief(s)

The writing of the challenge brief, that is the document eventually released to the robotics community, required to translate the proposal once more. While the healthcare challenge still largely focused on the aforementioned 'functional' aspects of a potential robotic solution, the former had to contain rather specific accounts of the technical parameters for *developing* the robot solution. This afforded a “translation transfer from what they [the hospital] want and what that means in the language of roboticists” (interview 1 ECHORD++, 09/06/16, my translation). This process involved the public body, AQuAS, and the robotics experts commissioned by ECHORD++, and allegedly meant “a lot of work” (ibid.). It involved a range of meetings in Barcelona as well as in Munich, where the different involved parties had to coordinate a decision on how to formulate the challenge brief (Interview 2 AQuAS, 12/02/18). Furthermore, this process involved not one but two attempts to call for proposals. It took them to re-write parts of the first version before they got proposals “with enough quality” (ibid.).

Here, it is important to note that these interfacing processes do not leave the involved elements untouched. Rather, translating ‘what geriatrics needs’ into ‘what robotics can do’, and *vice versa*, involves reconfiguring the former (and, incidentally, the latter, see section 6.4.). The following example is a quote from the first version of the challenge brief and suggests a way for proposals how to circumvent some of the complexities of the CGA procedure.

> “The questionnaire-based tests require advanced interfacing modalities and advanced technical cognition (artificial intelligence) because the test’s questions are usually open and there is a need to interpret and codify the patient or relative’s answers. However, an [sic!] useful alternative may be to change the questions in closed ones with pre-defined answers where patient or relatives may select an [sic!] specific option through interaction with a device like a touch screen.” (Challenge brief, version 1, p. 1)

To (technically) interface[103] a robot with an elderly person for 40 to 60 minutes[104] denotes a task of extreme complexity for robotics. In fact, during the field tests in October, 2018 one of the robotics told me that the kind of tests they demonstrate there denote already a great achievement (field note, 17/10/18). Those tests took around 20 minutes. As an alternative to solve such a problem in technical terms and in order to make the CGA do-able for robotics, the challenge brief proposes to simplify the CGA procedure. As I have shown in the previous chapter, this is a common strategy of robotics when it comes to user-robot interaction. Here, however, we do not talk about prototypes of an R&D project but rather about the effort to commercialise a robotic product. It shows how such workarounds can change profound aspects of geriatric practice, such as turning a questionnaire form open to closed questions, thus

[103] The term ‘interfacing’ is a more or less common term in robotics and interface design. Contrary to the theoretical project of this book this refers to the technical aspects of enabling humans and machines to communicate with one another. In this context, it refers to advanced techniques of speech as well as touch screen interfaces, which are important to enable human-robot interaction throughout the assessment.

[104] As is the benefit of a robotic solution expected by the challenge brief (see version 2, pp. 20-21).

restricting the kinds of information through which the lifeworld of patients can be represented and evaluated in the assessment.

In this section, I have shown that instead of simply satisfying the need of a public end-user, the PDTI process extensively interfaces what geriatrics might need and what robotics can offer. This includes other considerations, such as, how a given challenge can help advancing the state of the art of robotics or how an envisioned challenge is scalable *vis-à-vis* the larger field of geriatrics. The whole setup of the PDTI to include public end-users in the creation of technical and social problems is embedded within the recent surge in more open and inclusive models of innovation within European policy discourse (European Commission 2016b, 2014a). While the promise of the PDTI mostly alludes to higher efficiency and quality in the translation of robot technology into marketable products, the involvement of (non-technical) experts presents innovation processes with the challenge to interface those who are involved. Here, interfacing robotics and geriatrics responds to the fundamental uncertainty about what a designated application area (like geriatrics) needs and what kind of solvable problems that holds for robotics. Both of those are not fully apparent neither at the beginning nor at the stage of the challenge brief. The different versions of interconnecting geriatric needs and robotic problems described in this section show that this uncertainty is never really dissolved but rather proceduralised, that is, infinitesimally translated to the point that a more or less stable set of interconnections (e.g. a particular challenge) can come into being. Here, the PDTI comes in as a particular device that allows stabilising at least the process through which those interconnections can be forged.

6.4. Affordable robots

The pre-requisite of ECHORD respectively the PDTI is to ‘solve’ public bodies’ problems with *robot* technology by adapting it to the formers’ specific needs. In the previous section, we have already seen that those needs as well as the robotic problems attached to them are a product of interfacing a number of concerns funnelled through their supposed do-ability. However, in studying the actual development process it becomes apparent that (a) there is more than one user involved in it and (b) in this process, the question of what a robot product should be becomes controversial. This is due to the circumstance that the PDTI engages and interfaces roboticists and prospective users. Here, roboticists and their designs are constantly confronted with, at times diverging, user requirements (plural!). In the following, I will show this with regard to two different design criteria: the interactivity as well as the cost of the robot. These two features became topics of controversy in the course of the development process since satisfying the one is perceived as threatening the other – and *vice versa*. Here, the question of what (un)makes a robot is at stake.

6.4.1. Users multiple

What is a robot? I have asked this question already. In innovation and funding policy discourse the notion of robots has changed with regard to where these robots are envisioned for application. Robotics describes itself as undergoing a paradigm shift from robots as industrial machines locked away in factory cages towards interactive companions working in close proximity with people. In the previous chapter, I have established that in practice there is not such a thing as *a* robot or robotics *per se*. Rather, when robots are constructed people from different disciplines and scientific communities come together and integrate demarcated areas of expertise and technological components. In the case of the PDTI, there is an additional dimension to this question, namely, that of what properties a robot needs to have in order to *still* count as a robot. When does a piece of technology cease to be a robot? This concern is opened up by the interfacing of particular design choices by roboticists and the requirements (plural!) by different user groups that are involved in monitoring the work of those roboticists.

As mentioned above users are involved in this project very differently from the case investigated in the previous chapter. While in that case users played the rule of test subjects who were confronted with a given technology in particularly staged environments, the PDTI process stipulates constant interaction between the hospital and the robotics consortia. This means that roboticists are confronted with those users in a very different way. Not only has the application scenario itself been interfaced with what geriatric professionals deem useful but users are also present during the various monitoring sessions and field tests. During testing in the premises of the Catalonian hospital this resulted in constant discussions of the robot design between roboticists, the geriatric physician mentioned earlier as well as the elderly users and other health professionals. User tests and presentations were followed up by feedback sessions and casual talk about what could be optimised and thus changed about the design. Nurses and doctors explained to the roboticists what is to be expected from elderly users and how that might be accommodated in the user interfaces. They also suggested additional or alternative features and functions that might be useful in their everyday work. For example, the CLARC system initially displayed the results of the geriatric tests as graphs. This was rejected by the health professionals, since they needed a solution where the results were easy to "copy and paste" into official reports and medical recommendations (Field note, 18/10/18).

In the following, I will concentrate on two different design criteria in particular: interactivity and affordability. These requirements were uttered by different user groups and conflicted in many ways.

6.4.2. Interactivity

Throughout the PDTI, roboticists were constantly confronted with contingencies of their design. A situation, which differs greatly from the way roboticists usually approach the interfacing of their technology with users. As a result, this affords a change in perspective *in* robotics as well as new forms of expertise. One of the roboticists expresses this as follows[105]:

> "I see the robot like a system with a lot of components, that are interacting among them and that must be able that the robot be able to localise himself or able to navigate by himself. I always try to put all the intelligence that we can put inside the robot but sometimes I lost the perspective of seeing the robot from outside, you know, like a user interacting with the robot. (…) It's the first time that I put in the part of the users and see that the robot needs to work on how to transmit the information not only to be able to process the information in the inside part of the robot but also how the robot is able to put the information in the outside and be able to connect and engage with the user that is in front of the robot." (Interview CLARC, 28/06/17)

In this excerpt, the roboticist distinguishes between two perspectives on the robot, the 'inside' and the 'outside' perspective. In his career as a researcher of artificial vision, he mostly focused on the robot as a closed circuit of modules that need to be able to communicate with each other in order to perceive the environment. By contrast, the CLARC project made it necessary to shift the perspective to the 'outside' of that circuit and towards the user and the question of how to enable her to better interact with the robot. Working on the CLARC robot design confronted the team with "new ways of facing the problems of robotics." (ibid.). On the one hand, this afforded new technologies, that is, new kinds of sensors such as lasers and infrared cameras. On the other hand, it also afforded to move the focus away from solely 'technical' aspects of processing information to issues of communication, i.e. the "user perspective" (ibid.). For this, they were asked by ECHORD++ to commission a new partner focusing on usability and user experience design in order to secure further funding within the PDTI process[106]. This new partner was needed according to ECHORD++ (and the geriatric physician), because the

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[105] It is important to note that the interviewee is not a native speaker and had some trouble articulating himself in English. My transcript strives to represent that. I have thus forgone any hints to grammatical mistakes (like 'sic' etc.) that might occur in the following excerpts of the interview with a CLARC roboticist.

[106] This subsequent addition to the CLARC consortium was possible due to the so-called cascade funding mechanism of ECHORD. It allows consortia to acquire new outside-services, i.e. redistribute their own funding after they have been granted a certain budget by ECHORD respectively the Commission.

geriatric assessment procedure requires the robot to be able to interact with the user, for example, giving instructions during the procedure.

Reacting to the requirement to include the user perspective (and this meant in particular: the elderly user) the CLARC consortium worked on rendering the robot more interactive. Feedback from tests with elderly users in a Sevillian hospital as well as in a French living lab resulted in changes of the design, namely, in regard to the speech interface, as the following quote shows:

> "We don't put very very importance to this question. We put a happy face and… But no, no, no, no, no. All things are important when you are using the robot, for example, with the elderly. They ask you that the robot approach to the elderly in a specific way, try to repeat the important things for the elderly, try to move the conversation to a more comfortable space, because the elderly knows the name of the robot, and the robot repeats the name to the person that is in front of it." (Interview CLARC, 28/06/17)

In this quote the success of the robot is not simply determined by the 'inside parts' of the robot, its technical aspects, but also by issues of the user interfaces and the interaction design. For the CLARC consortium it became an important design criterion for users to find the interaction "nice" (ibid.). Additionally, foregrounding the interactivity of and the user experience with the robot makes elderly people the primary reference point for this decision. In fact, CLARC cooperated with the additional partners from France by conducting a series of field-tests in order to enhance the user experience for elderly people in particular (Interview 1 ECHORD++, 09/06/17). While this attempt to render the robot more interactive certainly seems to concur with the initial requirements, it also means the foregrounding of a particular group of users: the elderly. This is important to note since the following paragraphs will show that there are also other users taking part in the process with completely different expectations *vis-à-vis* the robot and the interaction with it.

6.4.3. Affordability

For instance, the health agency AQuAS argues that the "new solution has to stress functionalities in order to be affordable for the hospital" (interview 2 AQuAS, 12/02/18). This mainly meant that the robot needs to gather more information and create more 'free' time for the doctors. In the process of writing the challenge the latter has been calculated as to how much time the doctor needs to save in order to make the technology cost-efficient for the hospital (ibid.). This was tightly linked to the fact that AQuAS was charged with the responsibility to decide in the end whether the robot designs are financially viable for the hospital in question. For them it was paramount that the projects could proof a net value for the geriatric unit, which proved to be configured mainly in terms of work hours saved versus the investment cost.

This meant that CLARC had a considerable disadvantage over their competing consortium, ASSESSTRONIC. While the former went with a mobile service robot platform (see figure 21) the latter went for a seemingly simpler design, a tablet connected with a camera and a data base. Here, elderly users would simply tap in their information via a conventional touchscreen and perform the gait evaluations in front of a visual sensor in a box (see figure 22). Naturally, this meant that the latter design was much cheaper than the mobile robot platform and thus more desired by AQuAS. Also, the geriatric physician preferred the simpler design, because it promised to be more reliable and easier to use than the mobile service robot.

Figure 21 The CLARC prototype (Nichols 2018)

Figure 22 The ASSESSTRONIC prototype, the 'camera in a box' (image: author, 17/10/18)

The simplicity of the 'camera in a box' sparked controversy within the PDTI, because CLARC argued that this would not constitute a robot . The roboticness of the solution denotes a fundamental prerequisite of the ECHORD++ framework overall. However, the geriatric physician did not care whether the solution is 'robotic' at all. Contrary to the initial premise of the PDTI he "thought in a technological solution for CGA process, not specifically a robotic device" (Email geriatrician, 11/12/17). This implied a different image of what robotics is.

> "Robotics means… (…) Some technologies altogether helps to mechanise a process. Not only a mechanical instrument. In this case, we thought, it's important how the elderlies are working, how things are going but what is not important is to assist him and that the elder has to interact with the robot. (…) We don't want to create some kind of machine to help the elder to do the assessment but we wanted a system that was connected and recorded information from one time to the next." (Interview 2 AQuAS, 12/02/18)

In these quotes, three things happen simultaneously: First, it seems to be the case that AQuAS as well as the geriatric physician do not care about the technological solution being specifically robotic. They simply seek a technology to 'mechanise a process'. This could be interpreted as, again, the distinction between what the solution requires technically and what it yields in geriatric practice, i.e. functionally. The solution should save time for doctors and leave more time for other activities. The technical ‘identity’ of the artefact does not matter to them. Second, this is tightly linked to their definition of what a robot is: A robot seems to trigger the image of a ‘humanoid’, which is not what they expect the PDTI consortia to deliver. Instead, they see robotics as “a technology that implies more things than robots”, namely, anything that helps to mechanise the CGA process (ibid.).

Third and most importantly, this is tightly linked to the specific relation between robotics and geriatrics materialised here. The robot should not interact or assist the elderly but simply record information from them. The system should obtain ‘objective’ data from the patient’s body and store it in databases accessible to the different health professionals involved in creating the individual care plan. Here, the specific ‘access’ of geriatric care to the patient comes in. Care here is invoked in a different way than compared to what I have discussed in the previous chapter. Geriatrics denotes a specialised *medical* field that is concerned with the *healthcare* of elderly people. The central problem of geriatrics is not the daily care of an elderly person as such but rather the accurate assessment of the ‘objective’ (medical, social, psychological, functional) status of a given patient. This knowledge then instructs and plans the daily care carried out by formal or informal caregivers. Hence, geriatrics materialises a “clinical gaze” (Foucault 2003b) detaching the patient’s body from its identity and individual experience[107]. Furthermore, it configures the way geriatrics practice can be mechanised in the eyes of the physician: as a means to render the gathering of data more efficient without the need to attend to the experience of patients during the test. In other words, applying a robot to the CGA is also a means to keep out any unnecessarily interactive or subjective aspects of human-robot interaction, since it would only deflect from the actual purpose of the CGA as conceived by the geriatric profession.

6.4.4. (Un)Making robots

The reference to costs shows that interfacing robotics and geriatrics denotes a particularly difficult case for Pre-Commercial Procurement. On the one hand, robotics is a very hardware intensive and, thus, expensive technology to develop (interview 1 ECHORD++, 09/06/17). Also the service robotics industry still mainly consisting of many SMEs and lacks big players. This

[107] Talking about experience is especially interesting here since during the CGA not only the patient herself is asked about her social environment and daily life. Rather, also her caregivers, formal or informal, are consulted here. This is to make out any inconsistencies between the two descriptions. In case of those, the physician usually believes the caregiver, as he remarks during one of the test runs in Barcelona.

means that a lot of companies do not have the competencies to manage and deal with the affordances of PDTI procedures (ibid.). On the other hand, healthcare sees itself under increasing "cost pressure" (ibid.). Thus, in order to make robotics work at the hospital, roboticists do not only need to work on interfacing elderly users and their machines through 'user interfaces' and 'nicer' interaction. Rather, they need to make robots cheaper for them to be compatible with the cost regime of care management. In order to make this work, the PDTI affords to profoundly reconfigure the robot prototype. Hence, roboticists are expected to adapt their robot design *vis-á-vis* those cost pressures. The CLARC consortium must "slim certain components" (ibid.) scrutinising every part of the design with regard to the question whether it is really necessary. ECHORD problematises a sort of over-investment on the part of roboticists, who want "to put all the intelligence … inside the robot" (interview CLARC, 28/06/17). For the overall mission of the PDTI to translate a given robot into a marketable product this over-investment is detrimental since it raises the cost of the device and thus the chances for it to prove itself on the geriatric care market. Hence, ECHORD disciplines the design decisions with regard to their economic justifiability. If they are not justifiable in that sense they need to be slimmed. However, these cuts do not simply reduce the functionality or cost of the robot but, according to the CLARC roboticists, threaten its very core:

> "OK, we can reduce the cost of the robot to the 25% by removing this part. I understand that this is not the question. I understand that the question is that there is different… A robot is not a PC, it's not a computer. And the robot is able to move. And this is the major difference between the robot and the PC. (…) So, the robot can be more expressive, can show different ways of interaction, can answer different questions, can accompany when you get tough on the chair it can move with you to the entrance. And these can be important for try[ing] to combine people that are not very familiarised to interact with these technologies. It's not easy. [laughs]" (Interview CLARC, 28/06/17)

The strategy of the CLARC consortium *vis-à-vis* the cost pressure in healthcare is, on the one hand, to cut functionalities. This however unmakes the robot, it turns the technology into a 'PC', which is not exploiting the potential of robots, namely, to be expressive and mobile. A PC is considered here an alternative, technically possible solution, which lacks certain features a robot can offer. So, on the other hand, the CLARC consortium tries "to sell more functionalities" (ibid.) for example, to offer walking support if the elderly need it. This also involves to find customers in "additional, potential markets" beyond the domain of geriatrics (interview 1 ECHORD++, 09/06/17, my translation). Only then, robots would prove themselves compatible with healthcare. It is interesting to see that the PDTI instrument, while aiming to transfer robot technology from lab to the healthcare market, it risks to unmake the robot's ostensibly core technological features. In order to be compatible with such markets, at least in the eyes of roboticists, it needs to become less of a robot.

In this section I have shown how the multiplicity of users involved in the PDTI process confront the roboticists with often divergent requirements. There are in fact different configurations of functional and technical aspects of robots, which starkly controvert each other. Roboticists need to somehow render these contradictory requirements available for one another and, in the process, produce a passable system. This however threatens to 'unmake' the very basis for the ECHORD project, namely, that its product should be a marketable *robot* after all. In the end, geriatric care appears to be a particularly difficult terrain for robotics, which affords the translation of what counts as a robot itself. This renders visible a central dilemma of the PDTI in particular but also the phenomenon of RobotCare in general. As soon as robotics endeavours to realise its 'universal potential' in care arrangements, the very line between its supposed identity and other competitive technologies starts to crumble. This also has an aesthetic or symbolic dimension to it. The 'camera in a box' seems to provoke controversy, precisely because it does not *look* like a robot. At the same time, prospective users need to be dissuaded from basing their ideas about (humanoid) robots on Science Fiction (see section 6.4). Hence, what constitutes a robot is also depending on symbolically interfacing different notions of what it could be, while never producing a definite identity. This makes the PDTI particularly risky in this respect. Translating robot technology to the point that it becomes affordable for a hospital risks to undermine the prerequisites of this translational process: that robotics is essentially different to other types of technology ('a PC') and to other types of funding areas (ICTs in general). In attempting to 'cash in' on the high-flying political hopes, robotics risks to lose its identity as uniquely innovative and beneficial technology. It is in this sense that the interfacing of robotics and geriatrics needs to keep out other (competitive) interconnections between care and ICT. For example, by making sure to exclude other possible solutions from the start, such as other software-based and 'incomplete' solutions already on the market or by declaring the 'camera in a box' a robot too.

6.5. Entrepreneurial roboticists

Roboticists are not simply required to be problem solvers, e.g. rendering the robot more interactive or less costly *vis-à-vis* particular user groups. Rather, they are required to think entrepreneurially about both their users as customers and their technology as product. After all, the aim of the PDTI is not only to develop a robot solution but also to explore and pursue possibilities to commercialise such a solution. Here, ECHORD++ in general and the PDTI in particular rest on the assumption that this affords entrepreneurial thinking on the part of roboticists. The entrepreneurial subject is invoked as the factor *par excellence*, on which the translation of robotics into the market depends. This is not at all given. Instead, in the case of CLARC roboticists see themselves primarily as researchers. The CLARC consortium does not have any business background[108], but that is not the case for all other PDTIs. Hence, another central challenge of the PDTI is to render roboticists entrepreneurial, that is, to dissuade them from purely focusing on technical efficacy and functionality of robot technology. In order to do this, PDTI mobilises a whole milieu of governance instruments in order to *produce* roboticists as entrepreneurial subjects.

6.5.1. The entrepreneurial personality

The entrepreneurial subject has traditionally taken a central role in innovation discourse (Godin 2015, pp. 231–234). For example, for Schumpeter and with regard to science and technology, the entrepreneur denotes "the mediator, the sheer translator, who brings together two universes with distinct logics and horizons, two separate worlds, each of which would not know how to survive without the other" (Akrich et al. 2002a, p. 188). Also the PDTI puts entrepreneurial thinking and action centre stage. Here, the entrepreneurial roboticist is positioned as the decisive factor to bring robot technology to market. One of the coordinators at ECHORD ties this faculty to a particularly entrepreneurial 'personality'.

> "Some do this very successfully. Well, if you look for example at the [experiment name] experiment [another funding instrument of ECHORD++, B.L.]. They have started with us. They will make heeps of money, right? That is really a thing for once, where I say, that is a model of success. However, that depends on the one who pushes this thing. That is [name] and he has that. It is a question of personality also. He has a completely clear sense for markets, for market potential. He knows exactly, into what kind of area he must thrust. And if he has realised that, nobody can keep him from doing that." (Interview 1 ECHORD++, 09/06/17, my translation)

For the interviewee, the above described experiment coordinator denotes the archetype of the entrepreneur, who spots and exploits market niches for robot technology. She depicts him not as relying on a certain skillset but rather on an entrepreneurial personality equipped with certain intuitions and imperturbability. Once he has locked in on a target, he will pursue and finish it. Next to being able to sense markets and exploit robot technology, the entrepreneur also fills the

[108] The only exception here is the company that provides the robot platform. This is rather specific to the CLARC case, since other consortia in this and other PDTIs do have a strong expertise in business respectively are led by companies. This makes CLARC a particularly good case to study the *enterprising* imperative of the PDTI in particular and ECHORD in general. The resistances described in the following section make visible the *translational* effects of such an imperative.

perceived gap "between manufacturers and the research community" (ECHORD++ 2018b). Just as the Schumpeterian entrepreneur people like the coordinator mentioned above are expected to render research and industry available for one another. The underlying assumption being that to conduct robotics research should not only solve a particular technological problem but also recognise and exploit its 'market potential'. We have seen this imperative already in chapter 4, where the topic groups of SPARC, the partnership for robotics in Europe, function as a vehicle to settle interdisciplinary, theoretical differences in favour of 'real world', i.e. market application. In the case of ECHORD, the pre-condition for interfacing research and industry, for translating robots into marketable products is delegated to the individual itself, black-boxed in the 'entrepreneurial personality'.

6.5.2. Disciplining entrepreneurial roboticists

However, as I will show in the case of CLARC, the entrepreneurial subject is not a given. The PDTI cannot rely on it as a pre-condition for translation. Rather the subjectivity of roboticists is itself in need of translation. Since the members of CLARC see themselves as researchers, the PDTI must entice and discipline them to view robotics not simply as a technological problem but as an opportunity for business. This becomes apparent in ECHORD's problematisation of the lack of business orientation not only within academia but also within the robotics industry as a whole. The objective thus is to cast out what the following quote identifies as a one-sided preoccupation with technology.

> „You have a lot of small and medium-sized enterprises, which do not cover all areas [of competence] …, which they actually need, in order to make the company successful. (…) And then you have a lot of people there, who are just very technophile, so mechatronics and so on and so forth, but who are not necessarily business oriented. A lot. And that is difficult then." (Interview 1 ECHORD++, 09/06/17, my translation)

The interviewee sees the (service) robotics industry tending to be focused too much on technological specificities of robotics. What we see in this quote is the opposition between two different orientations of robotics: One is focused on developing a particular technology in the most efficient way. The other is focused on business, on marketing such a technology and on attracting "venture capital", which is difficult due to robotics' reliance on expensive hardware (interview 1 ECHORD++, 09/06/17, my translation). To remedy this 'gap' is not an isolated mission of the PDTI but is rather embedded within European innovation policy discourse striving to "make Europe more enterprising" (European Commission 2014a, p. 67). This is understood as a challenge to essentially interface businesses, universities, public research organisations, financial institutions and nation states under the single rationality of bringing knowledge and technology to the marketplace. In other words, instead of simply bringing together industry and academia, this interfacing requires to reconfigure *both*, academia *and* industry, in terms of an entrepreneurial rationality.

In this context, ECHORD in general and the PDTI in particular attach urgency to the task of re-orienting roboticists towards entrepreneurial norms and principles of business and away from the problem solving tradition in engineering disciplines, such as, mechatronics. This re-orientation materialises in the PDTI's project governance, that is, in the instruments it uses to monitor and evaluate the participating actors. I would even argue that it is one of the primary challenges of the PDTI to establish a standardised governance structure orienting roboticists and others in the direction of entrepreneurial goals and values. As described above, this structure is represented by three different phases[109]: designing a concept, prototyping, and small-scale testing (see figure 23). In the first phase, the consortia are mostly left to themselves, that is, they are not monitored during this phase. Here, ECHORD++ as well as the public body are only "dialogue partners" (interview 1 ECHORD++, 09/06/17, my translation) available at the point of need. They did not actively intervene in the process. This combination of low funding and lack of monitoring was an intentional measure to test the readiness of participants to interact with the public body and to invest themselves in the PDTI.

> „However we wanted – and this was a problem, which we had in many Experiments [again, another funding mechanism in ECHORD; B.L.] – we liked to have consortia, which are hungry. And you see how hungry a consortium is, if you leave people to themselves. Right? There you notice already how much interaction, well, whether they come or not." (Interview 1 ECHORD++, 09/06/17, my translation)

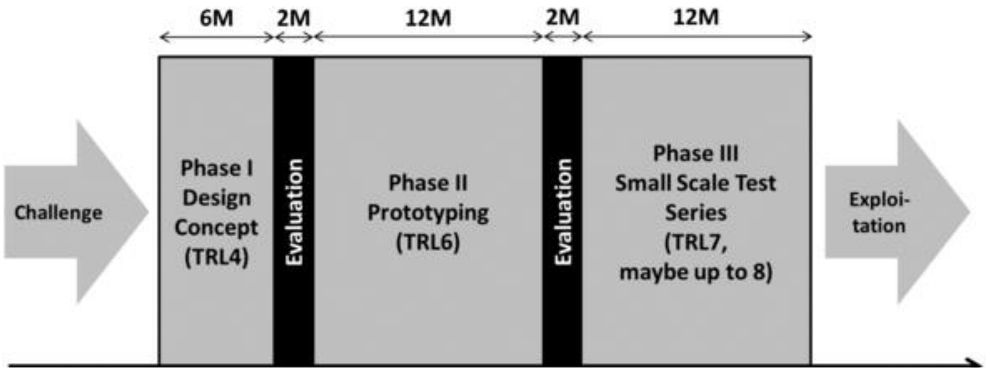

Figure 23 The PDTI process (ECHORD++ 2018c)

[109] How this procedure plays out in practice might be different across the different challenges. That is why, in the following, when referring to the PDTI I will always refer to the particular realisation in the case of CLARC respectively the PDTI on healthcare.

Hence, the first phase is a way to stimulate the consortia to invest more effort than their competitors into the development of a concept. The level of the consortia's own initiative then informs the evaluative selection process afterwards, where one of the consortia is eliminated from the process. This whole concept phase thus denotes a governing mechanism in order to distinguish between consortia that are 'hungry' and the ones that are not. In the case of CLARC, this resulted in an unexpected investment. The team did not abide by the initial intention to only develop a mock-up for the demonstration at the end of phase one. They brought a functional prototype, which was much more expensive. This meant that the consortium had to invest considerable funds that were not covered by ECHORD++. One of the roboticists said that the team felt that such an "up-front investment" (Field note, 17/10/18) was necessary in order to persist in the PDTI process. This was not guaranteed of course but it was a risk that they were ready to take. In the end, this incident was explained as a misunderstanding between CLARC and ECHORD++, but it nevertheless shows how robot developers are implicated in the PDTI process: as competitors who, in order to secure further funding, need to take risks and invest more than the other consortia. It is important to note that this investment is not only of intellectual but also financial nature.

In the following phases, the governance corset is much tighter. Here, the progress of the consortia is regularly checked via monitoring sessions as well as field tests. What consortia need to deliver is determined in so-called 'Key Performance Indicators' (KPI), that is, standardised benchmarks, which allow reviewers to compare the progress of the different consortia. KPIs are a common means to govern projects in business management. In the context of PDTI, these are used as a way to render the different outputs by the consortia comparable and measureable. Additionally, these KPIs hold assumptions of what counts as valuable output. Here again, we see a shift from traditionally scientific indicators to more entrepreneurial parameters:

> „Well, a KPI document again, right? We also have dissemination, you know. And then they [the robotics consortia] come with their papers. That is nice. They can gladly submit them. (…) However, we are not interested in that. What interests us, is, how much contact do they have with customers? To what extent… What kind of feedback do they get from customers? Do they have a first contract? Have they submitted a patent? Those are things that I am interested in!" (Interview 1 ECHORD++, 09/06/17, my translation)

In this quote, we see again a distinction between parameters of scientific and entrepreneurial practice as well as a re-orientation from the former to the latter. While scientific indicators, such as publications are essential for research, they are not deemed important for the PDTI process.

Parameters such as patents and contacts to potential customers are valued over classically scientific indicators. It materialises the logic of the evaluative infrastructure in which scientists need to prove themselves and, which decides what counts as success and what not. Roboticist researchers need to prove themselves as entrepreneurs.

6.5.3. *Coaching entrepreneurial subjects*

The PDTI not only sets entrepeneurial criteria for the work of roboticists. It also stipulates them to be coached about business-related skills, such as writing business plans. For example, during the field tests that I attended in October 2018, the ECHORD coordinators organised a workshop where the present consortia should learn how to develop a business case for their developed prototypes (Field note, 18/10/18). This, on the one hand, affords roboticists to present their work in a new format, the business plan. During the workshop meeting I was present, the coach urged roboticists to use pictures and illustrations wherever they can, since investors 'have no idea' about the technical particularities. The coach also emphasised to write in an easy to understand fashion. On the other hand, and this is maybe more important here, writing a business plan includes different parameters through which roboticists should evaluate their work. For example, the consortia need to value the eventual spin-off, calculate precisely how much a customer would save by buying its product, the its market price as well as the payback that a sponsor can expect from an investment in the company. Coaching does not only denote a way to optimise the respective robotic prototype but also a way to re-orient roboticists' attention away from the mere technical aspects of the prototype towards more business-oriented criteria. Throughout the workshops roboticists learn how to speak and write about their prototypes in front of lay investor audiences. This involves a different style and logic of presentation. They rehearse here their role as entrepreneurial roboticists in front of potential investor audiences (Shapin 2008, pp. 276–282) – albeit in a very prototypical way.

Another example for this are public relations respectively outreach activities. Roboticists are expected to make their scientific findings and technological developments public. As one member of the ECHORD++'s PR team puts it: "Science is not complete if it is not communicated" (Interview 2 ECHORD++, 09/06/17, my translation). Communication to non-scientific publics is positioned here as the key parameter with regard to which science becomes a success. In my conversations with interviewees from the ECHORD consortium they would state that, of course, communication amongst scientists is important, too. However, in the end, what counts about science and its communication is that science 'finds its way outside'. Science needs to "create impact" and "additional value" (ibid.). While such an orientation towards societal impact is almost commonplace nowadays in (European) funding policy, ECHORD++ attaches to this an explicitly entrepreneurial ‘drive’. Here, it shows that the task of engendering public relations is tightly linked to at least preparing the commercialisation of robot technology.

> “But at least the basis is already laid out, so that they can say ‘Great product, we will develop that now on the market’, so that they do not start at zero when it comes to reputation. But so that they can say we already have some people who have heard of it, ideally the right people.’ That is what facilitates the access to the market later.” (Interview 2 ECHORD++, 09/06/17, my translation)

In other words, the main reason for making scientific results and activities visible to non-scientific publics is not to educate them but to entice them about the market potential of robot technology. PR denotes an instrument here to prepare the conditions for finding potential investors or customers. Thus, the ‘art’ of PR lies in identifying and targeting potentially interested groups. In the case of the PDTI healthcare, these are not so much elderly people, as the interviewee states, but rather doctors and healthcare managers. For example, ECHORD++ aims to target those groups by placing advertisement in pertinent journals and other types of media (ibid.). Another strategy is to leverage consortia’s presence on industrial fairs and exhibitions. For example, ECHORD++ has its own booth at the renowned AUTOMATICA fair taking place annually in Munich (see figure 24), where consortia are expected to make contact with industrial partners and potential customers.

Figure 24 ECHORD++ booth at AUTOMATICA in June 2016 (image: author, 27/06/16)

Looking at these outreach and dissemination activities as well as their monitoring through KPIs renders visible a whole milieu of elements, which aim to subjectify robotics researchers as entrepreneurial roboticists. Here, roboticists are not only expected to stage their results and activities *vis-à-vis* society in general but rather to target specific publics, which might be actively interested in helping to translate a given prototype further towards its marketisation. Under the condition of such an "academic capitalism" (Slaughter and Leslie 1997), knowledge and technologies are constantly presented with regard to their economic and functional appeal, not their technical specificities or epistemic particularities. However, it is not only those products, which are implicated in this milieu but also the roboticists themselves. The various techniques of coaching, monitoring, and staging are thus taking effect as technologies of the self (Foucault 1988; Möllers 2016) in turning roboticists into entrepreneurial roboticists, who need "to entice – scientifically and entrepreneurially" (Daston and Galison 2007, p. 383). In turn, robots do not simply feature as prototypes of artificial vision or mechatronics but as "wares in a shop window" (Daston and Galison 2007, p. 383).

6.5.4. Precarious entrepreneurship

While this analysis shows how entrepreneurial roboticists are *expected* to act and think, there is another dimension to this. In the case of CLARC, roboticists continue to see themselves as researchers but are becoming entrepreneurs not only in the sense described above but rather they do so with regard to their own academic work. The following interviewee, a member of the CLARC consortium, phrases this with regard to the 'problem with the money' in his everyday life as a researcher:

> "I will be very very sincere with you. I am from the academic part of this problem. So, when we work on robotics, we don't need to sell robotics to anybody. I am from the academic part. So, we are solving problems, without taking into account the money. For me, the money is a problem all day, because we have at the lab four, five researchers now and we need to pay every month for them. But, this is my problem with the money. If I have a robot, I have a robot and the money that I can take the money that I can take." (Interview CLARC, 28/06/17)

Hence, the governance structure of the PDTI does not necessarily bring about entrepreneurial subjects in the sense that they are willing to sell and advertise robotics to end-users or investors. Rather, projects such as the PDTI feature central in the day-to-day task of financing research. This can be viewed as a sort of resistance against or renouncement of the entrepreneurial logic described above. In another instance, the interviewed roboticist states that this is also the reason why cutting costs for the robot is not a big problem for them, because they can still use the developed components in other projects (ibid.). However, it also shows that the entrepreneurial still affects roboticists' work, just in a different way. An example for this is the aforementioned incidence, where the CLARC consortium invested considerable (financial) effort in building a prototype in order to remain in the competitive PDTI process. Here, the roboticist becomes an "entrepreneurial self" (Bröckling 2016) with regard to their own research practice not to 'make heeps of money' on the geriatric market but rather to be able to continue doing research at all.

In this section, I have shown that considerable effort is invested into making roboticists entrepreneurial subjects. This materialises in a re-orientation in the kinds of monitoring practices as well as the kinds of criteria, on which they are based. Roboticists should not (only) prove themselves *vis-à-vis* traditionally scientific parameters but (also) need to engage into additional activities such as filing patents, writing business plans and interesting potential customers and investors. This is not something that is given by way of an 'entrepreneurial personality' but rather needs to be laboriously *produced* through a number of monitoring, coaching, and staging practices. Roboticist researchers need to be translated into entrepreneurial roboticists, which are able to satisfy both worlds, science and business. Hence, entrepreneurial roboticists are expected to entice both with regard to their technological 'excellence' and their entrepreneurial 'finesse'. In the end, however, this does not necessarily mean that roboticists become entrepreneurs in this sense but rather that the conditions for doing robotics research become increasingly risky and precarious. Here, the PDTI extends the competitive structure of third-party funding into the whole process. In this sense, entrepreneurial roboticists need to respond flexibly to changing circumstances and, at times, take financial risks in order to stay in the process.

6.6. Translational mode of interfacing

At the outset of this chapter I argued that even though (or rather because) robots still denote a rare exception in actual care practice, an apparatus of innovation attaches unprecedented urgency to the task of *translating* robot technology into marketable products for elderly care. The case of this chapter, the CLARC project respectively the PDTI on healthcare, promises to at least prepare such a translation. Here, the analysis has shown that this attempt, in fact, involves a range of different translations. To be more precise, the PDTI procedure has operated as an interessement device, which worked to redefine the identities and concerns of the manifold (human and non-human) actors involved in the project. Those actors have continuously been rendered available for one another to produce prospective users, do-able needs, affordable robots, and entrepreneurial roboticists, which make the core components of this translational milieu. I will briefly summarise these results before showing how they together exemplify a *translational mode of interfacing*.

The first component of this translational milieu are *prospective users*. Here, before the actual development process (i.e. in CLARC) can even begin to operate the PDTI process is confronted with the problem that public end-users, the designated target for robot technology in this case, are hard to find respectively difficult to convince to participate. This is especially problematic since the role such users should play in the PDTI is rather specific. First, unlike common public procurement schemes, they should not be interested in 'best value for money' but rather in facilitating and investing in robot technology that is not yet on the market. The PDTI requires public bodies to assume risks and the role of an investor interested in the eventual benefit of a tailor-made robotic solution in the future. Second, users are asked to prospect possible application scenarios in their respective field (geriatrics in this case). Here, health professionals, such as the geriatric physician are incited to problematise their occupational practice in light of supposed potentials of robot technology. This distinguishes geriatric care into parts available and parts unavailable for 'mechanisation'. The geriatrician's application scenario manifests a specifically medical position acting as a "spokesperson" for what care in general needs from a robot (Akrich et al. 2002b). This position values medical/analytical tasks over assistive/repetitive ones and thus releases the latter for automation. Part of the condition for translating robots into care products thus lies in the selection of *particular* prospective user (here: the geriatric physician) to steer the interfacing of robotics and care.

Based on this subjectification of the prospective user, the PDTI distils *doable needs* by interfacing what geriatrics might need and what robotics can offer. Here, the problems is not only that prospective users do not know about robotics but rather that they do not know the 'right' things about it. Their image of what a robot can do is informed by media representations, which must thus be disciplined by what the (limited) state of the art of robot technology can offer in 'reality'. More concretely, producing doable needs involves interfacing technical and functional aspects of robot designs in that certain requirements on the user's end need to be translated into feasible and intelligible parameters for robot development. This is not done by the user alone but rather denotes an assisted process, in which different positions (the ECHORD consortium, AQuAS, a robotics expert board, and the aforementioned physician) need to weigh off and negotiate their requirements for a doable 'healthcare challenge'. This means that in the process also geriatric practice itself does not remain untouched but rather must in part be adapted to a robotic solution, that is, what it can or cannot do.

In turn, the task to develop *affordable robots* implies to deal with the requirements of multiple users as well as with different expectations of functional respectively technical features. For instance, while the geriatric doctor as well as the health agency only need the robot to collect data in the most efficient way possible, tests with elderly users seem to suggest a more interactive design. Roboticists need to somehow render these contradictory requirements available for one another and, in the process, produce a passable system. For example, the CLARC roboticists, confronted with the cost pressure of healthcare, then need to position expensive functions, like interactivity and mobility, as additional benefits for markets beyond geriatric care. However, translating robot technology into an affordable product risks to 'unmake' the supposed essence of what constitutes a robot in the eyes of roboticists. It also undermines the basic prerequisite of the ECHORD++ project, namely, that the PDTI's product should be an affordable *robot* after all. This renders visible a central dilemma of the PDTI in particular but also the phenomenon of RobotCare in general. Approximating robot technology towards the status of a geriatric product seems to be confronted with a particularly difficult terrain. While robotics (still) denotes a very expensive, hardware-intensive technology, it finds healthcare under increasing pressure of cost-efficiency. Here, robotics seems to either fail to meet that challenge or be stripped down to an 'iPad on wheels'. This stays in stark contrast to the resonant promise of robot technology to save cost in the delivery of care.

Overcoming such difficult terrain affords the interfacing of *entrepreneurial roboticists*, who know how to strike a balance between technology and affordances of the market. However, this subjectivity is not a given in the case of CLARC. Members of the developer team largely see themselves as researchers, not as entrepreneurs. As a response, the PDTI installs a whole milieu of monitoring, coaching, and networking techniques in order to nevertheless fit roboticists into an entrepreneurial mindset. For example, roboticists are expected to satisfy elderly users' preferences but also to strategically position themselves on a (geriatric) market. For this, the PDTI stipulates particular criteria to assess roboticists' success on that front. Here, it is not traditionally scientific criteria that matter but rather business oriented ones, such as, filed patents, customer contacts, and investors' interest. This does not mean that they are exempted from being researchers. On the contrary, roboticists need to entice both scientifically and entrepreneurially. In workshops and on industrial fairs they rehearse such a new way of relating to robotics, not as products of science but as wares to be advertised and marketed to 'lay' publics. For this, the PDTI provides an extensive infrastructure of public relations, stands at trade shows, and coaching. However, such interessement does not necessarily mean that roboticists conform to this entrepreneurial rationality but rather that doing robotics research functions under increasingly competitive yet unrecognising conditions.

Analysing these four different sets of practices has emphasised varying aspects of interfacing geriatrics and robotics. For example, while in the beginning it is mainly the prospect of the geriatric physician, which needs to be adapted to robotics' limited state of the art (see 6.2.), it later becomes clear that also the robot design needs to be profoundly adjusted to the functional and financial requirements of geriatric care (see 6.4.). However, all these aspects need to be viewed together as part of a single *translational* mode of interfacing. This mode has two aspects: (1) it is part and parcel of the imperative to transfer the interconnection of RobotCare from one domain (research in the lab) to another domain (the geriatric care market) by installing particular translational milieus, which are not entirely science nor market. (2) Such a milieu needs to interest a range of actors from both sides in order to translate RobotCare in such a way that it might pass as a marketable or at least promising product. However, such translations can yield highly unpredictable results.

First, the present chapter has shown that neither the CLARC consortium nor the PDTI or ECHORD++ operate on their own. Rather, they are highly integrated into what I have earlier analysed as European innovation policy discourse (see chapter 4). Here, it is especially the imperative of transferring (robot) technology from the laboratory to the market, which underlies the interfacing practices described above. Especially, the PDTI takes an important position here as an interessement device positioned as 'right' between development and the market. It is important to note here that this 'middle position' denotes rather the rationality of the PDTI itself as well as respectively the attached discourses of technology transfer than the reality 'out there' (Visvanathan 2001). Using the terminology of an analytics of interfacing, the PDTI engenders its own translational milieu, which follows its inherent operational logic. It creates a sort of self-contained zone, in which marketability, do-ability, and functionality of 'robots in care' can be further tested and explored – but also temporarily suspended, delayed or absorbed. So, rather than simply bringing industry and academia, robotics and geriatrics 'together', it affords their mutual translation under the procedural order of the PDTI, where users must be convinced, healthcare challenges forged, robots trimmed, and roboticists re-sensitised.

Second, the procedural order effected by the PDTI does not require the participating actors to simply change individually but rather they need to do so in regard to one another. Roboticists must orient their designs to the often diverging requirements of robots in healthcare, which confronts them with increasingly difficult trade-offs between functional, technical, and financial parameters. Prospective public end-users need to invest into a product, whose capabilities foremost disappoint preconceived ideas about what robots are able to do. Last but not least, roboticists are inflicted with the task of not only getting the technology 'right' *vis-à-vis* public end-users' needs but also, beyond that, entice additional publics, such as customers in opportune niches or investors. After all, such translational interfacings do not produce individual interested actors, e.g. “innosumers” (Peine et al. 2014), but aim to install a more or less “obligatory passage point” (Callon 1986, pp. 205–206) for RobotCare to be admitted through (or not). Such a translation is never fully accomplished in the present case. Even if one of the prototypes developed in the course of the PDTI is chosen by the hospital, this does not mean that there now is a marketable product ready to be shipped and sold. Rather, translational interfacing turns out to be an ongoing process that infinitesimally approaches and simultaneously expands towards a state of ‘almost’ market-readiness. While the precise nature of that ‘final’ state is never really apparent its possibility nevertheless guides the continuous addition of ever more actors on the way. Potential investors, alternative markets, and customers continuously extend the milieu of the PDTI. As an effect of this dual dynamic, the many translations that RobotCare has undergone diversify and contract at the same time. While CLARC needs to be on the lookout for further applications and thus further going redesigns, their competitor might ‘cash in’ on robotics’ promise to transform society by way of a ‘camera in a box’.

7. Techno-politics of innovation

The starting point of this book was the observation that for policy makers, business consultants, and engineers alike it has become inherently plausible to talk about interactive, social robots and elderly care all in one breath. At the same time, when following roboticists (and robots) into the lab, this interconnection is not so self-evident anymore. It proves to be extremely hard to make robots interact with elderly people and their life worlds. As a result, I have endeavoured to put into question the matter of course, with which European innovation politics talks about and acts on the interconnection of robotics and elderly care. Based on this, I chose an approach, which has not taken RobotCare as already accomplished or impossible to achieve but rather as the (more or less stable) product of an ongoing interfacing process, which has rendered robotics and elderly care interconnectable. This approach was based on and enabled by an analytics of interfacing, which in a similar vein as Foucault (1984, p. 49) takes the interconnection of robotics and elderly care as a particular form of problematisation, which configures RobotCare as a predominantly technological problem: to construct robots for an ageing society. This neither denotes a historical necessity nor simply a product of random variation. Instead, the plausibility and desirability attached to this project is depending on the persistent action of rendering both, robotics and elderly care, available for one another. As a result, I have sought to answer the following question: *How, under what kind of conditions and through what kind of modes, have robotics and care been interfaced within the context of European innovation politics*?

Guided by this overarching question, the present book has conducted three case studies pertaining to European innovation policy discourse, HRI experiments in a robotics R&D project as well as a public procurement project within the context of the ECHORD++ coordination hub. For each of them, the analysis has identified one predominant mode of interfacing, that is, one particular set of recurrent rules of operation that shape the way robotics and elderly care have become interconnectable: *infrastructuring, prototyping, and translating RobotCare*. In the introduction, I have presented the prospect of not taking these case studies as separated but rather as a series, i.e. I was as interested in the similarities and more general analytical relations between those individual studies.

In order to elaborate this, the following summary of my empirical results will be organised not according to those individual contexts but rather with regard to the herein identified modes (7.1.). By doing so, I endeavour to show that each of these modes can be applied to examples from the other case studies thus allowing me to saturate the extent and meaning of each of these modes. Based on this summary of empirical results I will argue that the phenomenon of RobotCare is embedded within a wider milieu of innovation politics and a profoundly technologising society. In doing so, I propose to take the phenomenon of interfacing RobotCare as demonstrating the need for an additional, analytical register *vis-à-vis* conventional Foucauldian analyses of contemporary power/knowledge: a *techno-politics of innovation* (7.2.). Based on this proposition, I will discuss possibilities for critique of a contemporary, techno-political positivity. Here, I try to lay the groundwork for a critique of technology, which neither reproduces nor negates socio-technical interconnectedness (7.3.). Such a form of critique takes as its central vector questioning the modes and conditions, under which *techno-social interconnectabilities* come into being.

7.1. Modes of interfacing RobotCare

The aim of this study was to take RobotCare neither as a ready-made accomplishment nor as an impossible pretension but rather as the product of a range of political, social, technical efforts interfacing robotics and elderly care. This has produced a heterogeneous panorama of material and discursive practices operating within different milieus. The analysis of such practices has rendered visible more or less stable, recurrent modes of interfacing RobotCare. Each mode exhibits a certain pattern with regard to how certain practices attempt to interface robotics and care. They take three different forms: *infrastructuring, prototyping, and translating RobotCare*. All of these modes relate crossways to the three case studies investigated in this book and are summarised subsequently in the following sub-sections.

7.1.1. Infrastructural mode of interfacing

This mode of interfacing most clearly identified in European innovation policy discourse refers to material and discursive practices directed at infrastructuring RobotCare, that is, at installing the conditions enabling and constraining the way robotics and elderly care could become interconnectable. RobotCare features here as a relatively distant vision *vis-à-vis* the grand challenge of demographic change. It does not correspond to a social, technical or political reality in the present but rather acts as a model for a desirable future. This desirability is rationalised in three distinct ways: as *active and healthy ageing*, *ambient assistance*, and *technological innovation*. Through these rationalities, interfacing operates by way of anticipatory preparation, where the threat of an overaged society in coming decades affords (re)infrastructuring milieus of science and innovation policy in the present. Interfacing thus acts on milieus, such as innovation partnerships or work programmes, in order to install the 'right' conditions for interconnecting technological solutions (e.g. robotics) and societal domains in jeopardy (e.g. elderly care).

In the case of EU funding policy, such conditions were installed by way of establishing *active and healthy ageing* as an overarching theme of ICT and health related work programmes. Most notably, this has effected a shift with regard to the disciplinary spectrum charged with tackling the grand challenge of demographic change. Here, the expected repercussions of an ageing society motivate R&D projects in the technical sciences. In this context, ageing is not conceived anymore as primarily a problem of biomedical expertise. Rather, it becomes (re)configured as a testing ground for assistive technology supposed to enhance the wellbeing of elderly people in everyday life. This re-infrastructuing the EU's work programmes effectively lends plausibility and desirability to the task of constructing (social) robotics as a technological solution for (social) care. Before neither of the two topics played a significant role in this context. This means that both domains do not simply get re-defined. Rather, they come into being in relation to one another. In other words, they become interfaced through the overall vision of transforming society in light of active and healthy ageing. This makes assistive technologies, i.e. social robots, *the* primary solution to enhance the quality of care for and the life of elderly people under the conditions of impending demographic change.

This connects to the second rationality of interconnection, *ambient assistance*. It has underlied the establishment and operation of the Joint Programme of Ambient Assisted Living (AAL). This infrastructural milieu has configured elderly care as a problem of daily assistance, where care practices are dissected into distinct assistive services available for automation. This not only manifests in the AAL programme but also in the experimental paradigms of robot development as exemplified by the human-robot interactionexperiments analysed in chapter 5. Here, roboticists aim to demonstrate RobotCare by way of engineering a set of distinct robotic services, such as, fetching a bottle of water or reminding the elderly user of their daily schedule. Such (more or less) standardised tasks configure the way assistive robotics accesses problems in care and, in turn, how robotic services are staged as supposedely useful *vis-à-vis* those problems. This plausibility does not necessarily rest on actual needs in care practice but rather owes itself to the infrastructuring of ambient assistance selectively (re)appropriating discourses on Independent Living and assistive robotics.

Furthermore, interconnecting robotics and care is positioned as a vehicle to attain *technological innovation*. This rationality has, on one hand, resulted in a transformative register regarding care-related funding priorities, where robotics and other assistive technologies are staged as underlying a profound re-design of European care systems. On other hand, it has resulted in efforts to (re)organise respective fields within innovation partnerships as a way to enable collective action with regard to those transformative expectations. While I have shown this in regard to innovation partnerships, this has resulted in the installation of further infrastructural milieus deemed to realise the target value of technological innovation. For example, ECHORD++ has been established as a platform within robotics to interface actors from industry and academia while at the same time positioning itself as an infrastructure to 'cash in' on robotics' promise to transform society. The PDTI procedure analysed in chapter 6 exemplifies these infrastructural efforts, since it is conceived as a model process, an innovation in itself for redesigning public procurement practice in Europe. In the end, PDTI is viewed as a device to standardise such practices across different sectors and contexts. Thus, ECHORD++ sees its mission not simply in translating robot technology in individual application areas but also in infrastructuring certain techniques and procedures of innovative procurement across the EU.

When speaking of an infrastructural mode of interfacing, the basic argument with regard to the phenomenon of RobotCare is that the matter of course, with which assistive technologies such as robots are interconnected with concerns of elderly care and ageing, owes itself not least to a long series of infrastructural efforts organised within a European apparatus of innovation. It has further established the kind of ready-made rationalities, which have rendered this interconnection plausible and even desirable. The infrastructural interfacings described above have installed the terrain, on which many of the subsequent interfacing practices depend. Thinking about interfacing in this way points to the embeddedness of RobotCare within broader political transformations as well as the longstanding infrastructural work goes along with those transformations.

7.1.2. Prototypical mode of interfacing

This mode of interfacing identified in chapter 5 refers to material and discursive practices oriented towards prototyping RobotCare, i.e. staging and tinkering with provisional interconnections between robotics and care, robots and elderly people. Here, RobotCare is configured as a test scenario whose future potential needs to be demonstrated under more or less 'realistic' conditions in the present. This is to say that such practices aim to *materialise* the future vision of RobotCare under limited, presently available technical and social conditions. Prototypical interfacings thus promise something, which cannot be fully realised. They operate by way of precarious experimentation, where the gap between present possibilities and future potentials needs to be aligned by theatrical alignment (Möllers 2016). In other words, prototyping RobotCare alludes to materially staging a testable future in the present (Dickel 2017, p. 181). On one hand, this mode of interfacing accounts for RobotCare as an open-ended process, in which provisional interconnections need to prove themselves in unpredictable terrain. On other hand, it alludes to treat these interconnections 'as-if' they were already realised, that is, as proxies for accessing that future. The kinds of prototypes this mode produces are not merely singular objects, such as a certain robot system. Rather, it engenders prototypical milieus, where the precariousness of such interconnections can be explored and their provisional stabilisation be staged.

This manifests most clearly in the HRI experiments analysed in the case of the robotics R&D project (see chapter 5). Here, it becomes apparent that roboticists, on one hand, demonstrate precarious interconnections between robots, elderly people and care-like environments. For this, they need to render the prototypical milieu of the test apartment 'robot-friendly' adapting users, mundane objects, and the testbed's surroundings to the robot's affordances. On other hand, and despite frequent breakdowns and failures, roboticists are expected to align these precarious demonstrations with the overarching vision of RobotCare. For this, they stage human-robot performances 'as-if' they were already (partially) realised by way of invisibilising the messy circumstances of the experiments described above. Taking both of these practices together yields insights into how prototypical interfacings operate by way of an internal tension. The messy circumstances of precarious demonstrations continuously threaten the roboticists' carefully staged dramas. Their dramaturgy must at times be suspended in favour of regaining control over the situation, for example, by fixing something in the robot in front of the test subjects' eyes. In turn, realism itself threatens the tests' 'robot-friendly' milieu. By restricting roboticists' control to backstage activities the robot is left more exposed to the uncertainties of interacting with 'real' users. All told, this means that prototypical interfacings are neither mere window dressing nor are they simply aimed at technically testing robots. In staging and performing robots in care as a viable option to help the elderly such experiments denote instances, where participants rehearse and act out those albeit inchoate interconnections between robots and people, robotics and care, a technology that is *not yet* and a society which nevertheless acts *as if*. In other words, it is through these prototypical interfacings that society explores and probes ways of accommodating robots in care.

However, the prototypical is not restricted to the demonstrations in robot development *per se*. In the case of ECHORD++ (see chapter 6), the 'Public End-User Driven Innovation' (PDTI) instrument is also positioned as a prototype or, should I say, a prototypical milieu of innovation policy. For the project coordinators of the ECHORD++ consortium the PDTI denotes an opportunity for exploring collaborative and co-creative processes of robot development with public end-users. Similar to the HRI experiments described above, the ECHORD++ is confronted with a number of unexpected problems, with manifold elements proving to be recalcitrant or unavailable: disinterested and 'uneducated' users, poor project proposals, and roboticist researchers, who are reluctant to conform to an entrepreneurial mind- and skillset. As a result, a lot of the methods and techniques are improvised along the way. Through these prototyping practices ECHORD++ promises to gather hands-on experience, expertise and best practices about facilitating innovation processes in robotics. Hence, such prototypical interfacings of public end-users and robot developers are staged as indicative of and instrumental to updating existing techniques and methods to steer innovation procurement across the European Union.

This aspect of staging alignments with policy expectations also applies to the innovation partnerships mentioned above. For example, the European Innovation partnership on Active and Healthy Ageing is positioned as marking an unprecedented moment of unity in the field of active and healthy ageing. As the partnership states in its implementation plan,

> "[i]t is the *first time* that such a broad range of stakeholders – from health and social care sectors as well as business and civil society – have *agreed on a shared vision and a comprehensive framework for action*" (European Innovation Partnership on Active and Healthy Ageing 2011b, p. 4, my emphases)

Hence first, the partnership does not represent an already established framework but rather unchartered territory for EU policy. It denotes the first in a whole series of partnerships launched in the aftermath of the Europe 2020 strategy (European Commission 2010a, 2010b). Second, these partnerships are a means to stage a whole field as being united around and conforming to the vision of active and healthy ageing. Innovation policy can now act as if this field exists attaching to it expectations about transforming European healthcare systems with ICT. The same goes for the SPARC partnership in robotics, which has helped *produce* a European robotics community interfacing formerly separated actors from industry and research. As a consequence, nevertheless persistent, disciplinary or political differences are invisibilised or backstaged through topic or action groups. This is to say that an essential part of these partnerships is their *performance* as legitimate proxies for whole fields, which otherwise might not even exist outside the realm of European innovation policy.

Viewing the prototypical as a specific mode of interfacing robotics and care means to not restrict the prototypical to a particular piece of technology, a robot for example, but rather to expand it to the very material and discursive practices, which bring them into relation through experimentation (Jiménez and Estalella 2010) and staging (Möllers 2016). Thus, the prototypical alludes to robot development as it does to policy formats or techniques of innovation management. All these different forms of practices have, in one way or another, contributed to experimenting and staging interconnections between robotics and care. It thus allows for acknowledging the scope of prototyping practices as vehicles for rendering society and novel kinds of technology gradually available for one another (Dickel 2019). Such a mode installs prototypical milieus, where experimentation can be used for engendering yet unknown interconnections while theatrically testing their yet provisional plausibility.

7.1.3. Translational mode of interfacing

This mode of interfacing identified in the CLARC case accounts for material and discursive practices oriented towards translating RobotCare from a prototypical vision of research into a viable, marketable product. Here, RobotCare is configured as a business case answering to the immediate needs of end-users and their respective domains. This is to say that such practices endeavour to, on one hand, interest an increasing number of actors (users, companies, researchers, customers, investors etc.) in the introduction of robots in care and, on other hand, reconfigure robots in such a way that they can become compatible with the practical requirements held by those actors. This process of mutual adaptation is not at all harmonious but rather gives room for new conflicts. For instance, there is great uncertainty about what robots can actually do in care practice. This is sought to be reduced by way of interesting prospective end-users. They should re-imagine their professional practice in light of robotics' potential. Furthermore, the underlying interfacings paradoxically create new uncertainties about what care might need and about what robotics might mean in this context. The product of this is not so much a ready-made product or a final solution to a former problem but rather a translational milieu, which in both expanding and contracting aims to install a more or less "obligatory passage points" (Callon 1986) for RobotCare to be admitted into designated application areas. This passage is not obvious from the start but needs to be gradually interfaced by mutually adjusting and translating an increasing number of elements – both technical and social, human and non-human.

This becomes especially visible in the case of ECHORD++ respectively the CLARC project attempting to develop a robot for a Catalonian hospital. Here, the 'Public End-User Technological Innovation' (PDTI) procedure promises to tailor robotic solutions to public bodies' practical needs. However, this does not mean that robots simply 'meet' those pre-existing needs but rather that both, robot technology and the supposed problem, need to be meticulously reconfigured and adapted to one another. For example, public end-users do not have the ‘right’ ideas about robotics and thus their needs need to be adjusted to what robots are actually able to do. In turn, robot technology is confronted with multiple, often diverging user needs. As a result, roboticists need to distil a passable design, which follows not necessarily what is technically feasible but rather what, for example, the public end-user is ready to spend. This requires roboticists to essentially take an entrepreneurial standpoint interested in the marketability of robotics not primarily in its technical finesse. Hence, the conditions, on which the translational agenda of ECHORD++ is built, are not in place from the start. Rather, all these different elements need to be translated in the course of the PDTI process in order to create a favourable milieu for robotics to become passable *vis-à-vis* its designated market, which in the process becomes decomposed into often conflicted needs by different actors. However, this does not mean that the PDTI simply connects the “lab to market” (ECHORD++ website) but rather that it stabilises a translational milieu, in which actors can become interested in the commercial viability of RobotCare – or not.

This translational aspect of interfacing RobotCare also becomes visible with regard to the test apartment analysed in chapter 5. The testbed is embedded within a local innovation network between companies, research institutions as well as the local municipality. Robotics research should happen in direct neighbourhood to actual care practice, which is supposed to be architecturally realised in the fact that the apartment is built into the environment of a local care facility. The spatial closeness between robotics and care is positioned as a vehicle to enable “shorter development time and a faster product launch” of assistive robots for care (Innovation network website). Elderly users are thus not only assumed as test subjects but also as potential customers and users of such technologies. Their presence in the lab functions as a testimony to the usefulness and (commercial) viability of robots in care. In this sense, the test apartment as well as the innovation network, in which it is situated, form another translational milieu, where different publics are worked on to become interested in the commercialisation of RobotCare.

Another example for this mode of interfacing can be found in the discourse analysis of European innovation policy (see chapter 4). Here, the genesis of the public-private ‘Partnership for Robotics in Europe’ (SPARC) can be seen as the product of a series of translational

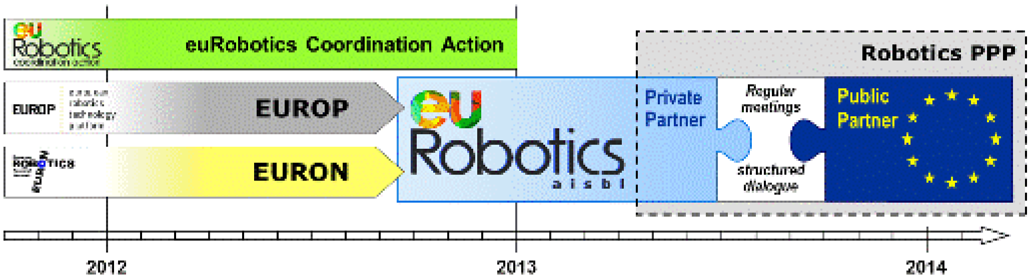

Figure 25 Timeline of the SPARC's genesis (euRobotics 2018a)

interfacings on the institutional level of European policy (see figure 25). The partnering of ‘European robotics’ and the European Commission afforded the translation of initially separated, ‘fragmented’ robotics networks (EUROP for industry and EURON for academia) into a unified, pan-European association, the euRobotics AISBL. This formation of euRobotics denotes the pre-condition for robotics to even become addressable as a partner for the European Commission. Chapter 4 shows that this has gone hand in hand with the translation of funding and research priorities. euRobotics seeks to interconnect (sub)disciplinary communities in robotics and reconcile their debates around “theoretical differences” (Interview innovation manager, 22/04/16) in favour of “innovation goals” (Partnership for Robotics in Europe 2013, p. 1). In order to become discursively compatible with the challenge of ‘transforming’ elderly care, robotics itself had to be translated into an *agent* of technological innovation.

The key aspect of a translational mode of interfacing points to the successive and simultaneous translations effected by interfacing practices. This analytical focus points to the unpredictable outcomes of such translational processes, where the question of how (technically, commercially, socially) successful interconnections between robotics and elderly care might turn out can if at all be answered retrospectively. Even if such interconnections come into being one way or another, this does not guarantee that, for example, a passable robot is still recognised by everyone as such and not denounced as a ‘camera in a box’. It is thus much more beneficial and insightful to focus on the kind of milieu (of people, technologies, spaces, networks, documents etc.) than simply thinking about the eventual outcome of RobotCare as a piece of technology.

7.1.4. Empirical insights for STS research

Studying the interconnection of RobotCare via material and discursive practices of interfacing across different milieus quarries the kind of social, political as well as technical work that has enabled this phenomenon to emerge in the first place. This rich empirical panorama demonstrates the advantage of a connected view and makes clear that further investigations in this matter are needed. While existing research in STS on robots in care and care in robotics has certainly laid the groundwork for such a research project (see chapter 2), the present study has aimed to add to this and centre attention on the manifold and multiple ways, in which robotics and care, society and technology are becoming increasingly interconnected. This helps to unpack a number of prevalent ideas about supposedly 'intelligent' technology and its impact on society at large.

The idea that robots and other forms of supposedely autonomous technology operate independent from social, material and political circumstances seems to be greater than ever. This view is deeply engrained in the cultural narratives surrounding and supporting more recent techno-scientific projects, such as AI or humanoid robotics (Suchman 2007, pp. 206–225). In the case of RobotCare, robots are commonly depicted as autonomous technologies ready to make care more efficient by assisting or replacing tasks classified as tedious or too expensive. Such a discourse materialises a techno-scientific, de-contextualised "gaze from nowhere" (Haraway 1988, p. 581), which simply confronts the immaculate machine with the fallible human (Heßler 2015). This is true not only for solutionist proponents of automation but also for its humanist critics (more on this in section 7.3). Here, an analytics of interfacing points to the manifold, *additional* and reconfiguring labours that produce robotics and care, robots and human beings simultaneously as interconnectable. It grasps the often invisibilised interfacing work installing the social and technical, material and discursive conditions for such interconnections to emerge. In this way, many of the recently surfaced visions of techno-social interconnectability, for example between artificial intelligence and healthcare (Ford 2015, pp. 147–153) or between neuro-technology and disability (White et al. 2014), can be viewed as relying on extensive processes of interfacing society and technology.

Furthermore, interfacing activities, at least in the context of RobotCare and similar phenomena, seem to be consistently future-oriented. Futures have been a long-standing concern in STS and innovation studies arguing that "visions have powerful consequences" in the present (Urry 2016, p. 7). In line with this scholarship the present study has shown that the far-reaching project of RobotCare is tightly connected to reconfigurings in the present. Take, for example, the longstanding efforts of re-infrastructuring European funding policy to accommodate a problem-based approach. While STS has traditionally focused on innovation discourses as a way to analyse the dynamics of future-oriented expectations over time (Borup et al. 2006; van Lente et al. 2013), the present study expands this focus towards the kind of material practices, in which current technological research and development is aligned with such visions. Here, one can witness that the future of RobotCare denotes an occasion to interface society and technology in the present and in different ways: (a) as a far-reaching challenge, which affords anticipatory political action in the present, (b) as a possibility space for techno-material experimentation, and (c) as a potential business case in search for do-able needs produced by prospective users. Interestingly, these different ways of configuring the future exist and operate simultaneously. This points to a wider societal context, which "is characterized by acceleration, a fetishization of the new, just-in-time markets, and a projection of the competitive horizon far into the future" (Brown and Michael 2003, p. 17). Hence, the way such a regime of the future takes effect should be studied through the (often long-standing) series of practices and milieus, which have enabled actors of different sorts to speak about and act on the components of those futures as interconnectable.

An analytics of interfacing also points to the reciprocity, with which elderly care *and* robotics are reconfigured. While the relationship between robotics and care is often portrayed as highly asymmetrical, where the former colonises (or disrupts) the latter, this study shows that the regime, within which robotics and care feature as components presupposes and works towards their *mutual* compatibility. This is to say that, while practices of interfacing usually (re)produce asymmetries between the involved elements, I argue that this is not due to essential, primordial differences between humans and machines (Turkle 2011) but rather due to the unfolding of historically contingent power relations (Foucault 1982). In this sense, an analytics of interfacing expands a Foucauldian, that is, relational perspective on power towards the specific way, by which contemporary societies deal with novel, emerging technology (more on that in the next section). The point here is that this moves the analysis from analysing individual domains or actors towards the modes by which they are related and, consequently, brought into being. In this context, it is useful to recall Pols' concept of 'fitting' once again.

> "When 'fit' as a temporary result in the process of caring is a criterion for calling care good or not, the goodness of the intervention, be it medical or spiritual, is contingent on the relation. Neither warmth nor coldness has a pre-given meaning that is hidden in the essence or nature of the intervention. (…) Fitting is a relational activity, a way of interacting rather than an effect of machines. Users and device s have to continuously establish what may fit where." (Pols 2012, p. 39)

Here, an analytics of interfacing would add that 'fitting' is not restricted to specific practices of caring nor is their supposed 'goodness' the only criterion that can be relevant. Rather, creating fits between technology and social practice becomes a pervasive task in contemporary technologising societies.

7.2. Techno-politics of innovation

Based on these empirical insights this book contends that the case of RobotCare as well as the modes through which it has been established throughout the past two decades are paradigmatic of a particular form of politics, a *techno-politics of innovation*. Indeed, I have repeatedly adumbrated similarities between RobotCare and other cases, such as the projects of telecare and ambient and assisted living. These phenomena are embedded within the wider milieu of European innovation politics as well as a society, which is deeply technologising. Here, technology conceived as technological innovation has entered the force field of contemporary political activity, with profound consequences for how government operates.

7.2.1. RobotCare and the techno-political problematisation of innovation

RobotCare has been established only due to manifold efforts of infrastructuring, prototyping, and translating manifold interconnections between robotics and elderly care. This is neither indicative of a historical necessity nor has it emerged out of random variation. Rather, they signify, what Foucault has called "a certain form of problematisation" (Foucault 1984, p. 49). In this view, RobotCare in all its facets rests on a recurrent but contingent form of organising knowledge, power, and subjectivity. In other words, it rests on the production of particular phenomena as problems and of their solution in political life.

I will illustrate this by way of the ECHORD++ case of chapter 6. To recap again, the basic premise of this framework in general and the PDTI process in particular, was that robotics responds to users' needs in society solving particular professional (and financial) problems in healthcare. The PDTI promises to bring together knowledge, technology, and people from both sides, robotics and (geriatric) healthcare, to eventually come up with and develop robotic solutions for identified problems. Despite the fact that this affords highly unstable and precarious efforts to interface both sides, the kinds of problems and solutions invoked in the process are not so much surprising. Rather, if one is aware of the European innovation policy discourse that informs this project, it is clear that technological innovations, such as robotics, are deemed the best way of solving societal problems as for example demographic ageing. Hence, the interfacing practices comprised in the PDTI process rely on a range of prefigured power/knowledge relations that plausibilise the application of robotics to geriatric care in the first place. There is a range of far-reaching assumptions engrained into the PDTI process. For instance, it posits that the primary function of science is to respond to and solve social problems (Kaldewey 2013), that the best way to achieve this goal is to enable innovation (Pfotenhauer and Jasanoff 2017), that innovation is technological (Godin 2015), that robots in its current stage hold benefits for healthcare, that users are aware of and receptive to those benefits, and, finally, that there is even a market for robotics in healthcare beyond the individual hospital in Catalonia, where the initial challenge was conceived.

Some of these assumptions have already proven to be rather unrealistic in practice. It is not at all self-evident that users are aware of robotics or that users are (financially) suitable for the healthcare market. It could be argued that the problems as well as the solutions identified by the PDTI could be configured in an entirely different way. For instance, the problem of the physician respectively the hospital that geriatric assessment takes too long and thus does not leave enough time for individual care planning could also be solved by employing more staff, by admitting less patients, by building more hospitals, by reorganising the procedure, by using other technologies available on the market etc. Even more importantly, such alternative solutions would reframe the initial problem: not as lack of time but as lack of financial investment, not as a problem of a doctor but as a problem of patients, not as a problem of the individual hospital but as a problem of the welfare system etc.

The sheer scope of alternatives renders the specificity and contingency of the problematisation visible, which underlies the interfacing practices observed in the case of the PDTI. Here, the primary solution is to delegate the task of geriatric assessment to a not yet existent technology. This is not only to solve a given problem in geriatric practice but rather to open up and exploit yet unchartered commercial potentials of robotics. In order to make this work, hospitals need to become facilitators of innovation and the geriatric physician in question must invest his time and creativity to come up with a challenge that is suitable for robotics. As a result, robot designs need to go through endless translations, adjustments and tests while roboticists are required to become entrepreneurs sensitive for market opportunities and ready to take risks themselves. Hence, the PDTI rests on the assumption of a *particular problematisation*, which makes this unlikely endeavour possible in the first place.

7.2.2. Three elements of a techno-politics of innovation

I argue that this problematisation is organised in a particular way, i.e. within a *techno-politics of innovation*. This regime is characterised by three elements. It (1) rests on a*rationality of interconnectability*, (2) it operates through a new political technology, an *apparatus of innovation*, (3) and it governs through *interfacing* formerly disparate elements. This regime is not entirely comprehensible by conventional accounts of bio-politics. The following discussion seeks to identify the limitations of scholarship *vis-à-vis* a novel techno-political "*positivity*" (Foucault 2013[1982], p. 141, original emphasis), while at the same time expanding on and adding to it.

7.2.2.1. Rationality of interconnectability

First, the phenomenon of RobotCare in particular and European innovation politics in general rely on the assumption that technology is almost universally interconnectable with any political problem or societal domain. Presuming such a 'universal' interconnectability denotes the central political rationality[110] of techno-politics. The interconnection of robotics and care within the European context is a good example for this. RobotCare hinges on the very assumption that those two domains, which for long had and in many respects still have nothing to do which each other, are, in fact, potentially interconnectable. For example, it assumes that solving the kinds of problems robotics works on nowadays, e.g. making robots fetch a bottle or warn an elderly person about a gas leak has use for the latter. However, this is based on a rather reductionist and stereotypical account of what caring for the elderly entails in practice (Neven 2011). In turn, such a political regime posits that confronting basic (and thus still rather unreliable) robotics research with care as a testbed will eventually lead to viable solutions to demographic change. This kind of rationality goes beyond the case of RobotCare. Telecare and ambient assistant technologies are framed in very similar terms *vis-à-vis* the grand challenge of an ageing society (Oudshoorn 2011; Peine et al. 2015). In turn, robot technology is seen to not only transform care but practices and sectors as diverse as rehabilitation, logistics, agriculture, public policing, and cooking (Partnership for Robotics in Europe 2013, pp. 37–58).

Such promissory discourse around emerging technologies is of course not an entirely new phenomenon (van Lente 1993; Borup et al. 2006; van Lente and Rip 1998). However, such discourses are more than simply the strategic positionings of individual technological areas. Rather, they are part and parcel of a political rationality, which constructs the world in terms of possible techno-social interconnections between social problems and technological solutions. While bio-politics has governed society by dividing it in terms of bio/medical codes of race, health, (re)productivity etc., techno-politics views the world in terms of infrastructural, prototypical, translational milieus, in which social problems and technological solutions ought

[110] I use the term 'rationality' in its Foucauldian sense not as representation of the world 'out there' but rather as that which rationalises and constitutes the reality, on which politics can act, see Foucault 1997b, pp. 129–130; Lemke 2001b, pp. 190–191.

to circulate and, in the process, interconnect with one another in (economically) productive ways. In this sense, the often-quoted "silver economy" (European Commission 2015b) is not so much based on the identification of certain bio-medical problems in an ageing society but rather on the positioning of old age as a resource for a technologically interconnected society. Thus it is the claim that robotics and elderly care are, in principle, interconnectable that underlies a far-reaching call to action in the present to install the right conditions for such interconnections to become reality in the future.

7.2.2.2. Apparatus of innovation

Second, this configuration of the world in terms of its techno-social interconnectability leaves the question of how to attain such interconnections. Here, techno-politics takes (technological) innovation as the model, through which it can intervene into a world that is not yet fully interconnected in the ways projected above. This requires to fundamentally re-design and transform the relations and elements involved. In other words, an apparatus of innovation has become its primary political technology. Techno-politics takes the attainment of "technical change as the model for political intervention" (Barry 2001: 2). This denotes a change in attitude towards political problems in general. For example, an ageing population has traditionally been framed in terms of an imbalance in the ratio between young, productive and elderly, unproductive parts of the population. Ageing thus meant a threat to the economic viability of Western societies (Katz 1992). In the context of RobotCare and other cases, one can see that this is at least not the primary concern of a European apparatus of innovation. Its main objective seems not to keep a balance, a "homeostasis" (Foucault 2003a, p. 249) but rather to profoundly transform elderly care systems around the vision of active and healthy ageing. This endeavour is not simply framed as a desperate attempt to 'defend' society from demographic change but rather as an anticipatory act to re-channel this challenge into productive pathways beneficial to business and the economy. Here, technological innovation plays *the* crucial role in both legitimising the measures described throughout this book and to attain the interconnections they project. The important point here is that innovation does not naturally place itself in between technology and society. Rather, this expresses a particular regime, in which they interconnect and become available for political intervention. In other words, innovation can only become so important, *because* of the establishment of the conditions described above.

This can be seen most clearly in the case discussed in chapter 6, where the marketability of robotic technology lies at the heart of the PDTI process. Hence, producing commercially viable innovation denotes the first priority of involving end-users in the design of a robotic solution to geriatric assessment. It configures the way how certain problems and solutions can become plausible while others remain excluded. Here, the PDTI does not search for a solution *per se* but rather for a *robotic* solution that can demonstrate the economic opportunities of an ageing society. The physician's application scenario must create an opportunity space for not just any solution but an innovative one. In turn, such a solution needs to enable geriatrics in ways, which would not be possible without a robotic device. It does not suffice to support a *status quo* but it affords to change how geriatric assessment is done and the kinds of conditions under which it is done. This is important precisely due to the supposed orientation of this translational milieu towards 'the healthcare market'. The robotic solution should not only satisfy the needs of the individual hospital but should rather attract the interest of further customers and investors beyond. Ironically, it is this transformative register of innovation, which all too often makes innovations fail, because it disregards the efficiency of established work practices, as Pols shows for the case of telecare (Pols 2012, pp. 130–131). This is not to say that such an apparatus would not work towards fitting robots and care practice. On the contrary, such innovation practices produce ever more of such fitting work and resolve it in different ways.

7.2.2.3. Interfacing as governing

Hence third, an apparatus of innovation requires to persistently interface what it perceives as interconnetable: robotics and elderly care, technology and society. In fact and as adumbrated above, the rationality of interconnectability first and foremost creates the world as both separated and interconnectable. The kinds of interconnections an apparatus deals with are mostly not yet fulfilled and still are in need to be realised. Hence, innovation in that sense really is a persistent call for creating the kinds of conditions, under which interconnections between the social and the technological can come into being. This however, requires additional work to govern the resulting impositions between social and technological orders.

Foucault has described how in dealing with the socio-biological 'reality' of populations, bio-politics needed to act in a "enlightened, reflected, analytical, calculated, and calculating" way (Foucault 2007, p. 71). As a result, bio-politics gave rise to new scientific methods and technologies to understand the nature of the population rendering it available for political intervention, e.g. statistical estimates and demographic forecasts. This has largely configured the strategies applied to demographic change by European funding policy. Indeed, until the 6th Framework Programme ageing was predominantly conceived as an epistemic problem of bio-medical disciplines. The aim was to evaluate current health care systems or forecast trends of population health in order to inform the government of an ageing population (European

Commission 2005b, pp. 52–53). However, as I have described in chapter 4, this has changed with an expansion of the disciplinary scope towards the technical sciences and especially to assistive ICTs. With it, also the modality of government has changed. Technologies such as robots or ambient devices are continuously tested out, probed and experimented with in prototypical milieus such as the previously analysed test apartment (see chapter 5). Here, the primary focus does not lie on gaining an objective insight into the life of an elderly population as it is or evaluating how it could be optimised. Rather, such a milieu prototypes possible interconnections between elderly people and robots taking these as provisional, inchoate realisations of the possible future of an ageing society.

As I have shown, such practices of experimentation rely on rendering elderly people, care robots, and care-like environments, available for one another. It requires additional work to somehow fit them in albeit provisional form. Such sites and practices of demonstration and experimentation are critical to a techno-politics of innovation, since they allow for testing out what interconnections between elderly people and robots, care and robotics might entail. Government here is not primarily calculated, analytical or 'enlightened' but rather oriented towards prototypically tinkering and trying out, what could in the end turn out to be the future of an ageing society. In this prototypical mode, governing does not follow a 'universal' representation of the population in terms of bio-medical categories but rather to gradually interface reciprocal impositions between social and technological orders. In this context, caring for robots and adapting the testbed environments to their needs denotes a way of governing such impositions.

7.3. Interfacing and critique

RobotCare owes itself to the emergence and operation of a certain type of problematisation, a techno-politics of innovation. In this context, interfacing takes the form of a specific way of governing the world in terms of its socio-technical interconnectability. As a result, interconnections between the social and the technological depend on the imposition of a particular techno-political order that enables them to emerge in the first place. In the following, I will adumbrate possibilities for reflexive critique *vis-à-vis* such a rationality of interconnectability. Since the two major discursive registers outlined in chapter 2 dominate the debate around robots and care, an analytics of interfacing might be instrumental for STS research and beyond putting into question the assumptions at work in those narratives. An analytics of interfacing might thus lay the groundwork for a critical project in the future, which neither reproduces nor simply negates socio-technical interconnectedness. Such a critical project might consist not in simply de- or reconstructing the essence of robotics and care, technology and society but rather in investigating and questioning the modes and conditions, by which they become ostensibly compatible with one another in the first place. In a techno-scientific world, where the social and the technological become more and more intimately interfaced with one another a reflexive STS perspective might thus, too, re-think its emphasis of socio-technical interconnectedness, precisely because it itself becomes a resource for power under the technological condition.

7.3.1. Techno-political impositions: a vignette

Before delving into such a discussion, I will briefly illustrate and exemplify the powerful impositions that go with interfacing practices by way of a vignette. The following scene has occurred during my field trip to the so-called "mid-term on-site monitoring" of the PDTI on healthcare (ECHORD++ mid-term evaluation agenda), where CLARC and its competitor consortium demonstrate their designs and collect feedback on them from elderly users, health professionals as well as the ECHORD coordinators themselves.

> **Techno-political impositions**
>
> Field note (17/10/18)
>
> The tests are scheduled to take place in the hospital's library, which resides in a former monastery. Today, CLARC is scheduled to test their system with elderly patients. The first test subject is an 85 year old man, who uses a walking stick and suffers from mild dementia. The physician escorts the patient into the library, about 25 square meters in size, and asks him to sit down on a chair. There are around eight people in this room waiting impatiently for the tests to commence. One of the CLARC members shortly explains to the patient that he should respond to questions uttered by the robot via a remote control, a white box with a number of large buttons on it, which have different colours and symbols. The robot plays its instruction routine and starts by asking the patient a question about activities of his daily life. He slowly looks up and down, stares at the remote control not knowing what to do. No response. The robot continues to repeat the question. Sometimes, the patient briefly looks up at the surrounding crowd and then down again. At one point, he mumbles an answer, but no response by the robot. It feels like ages before the physician finally takes care of the situation and leads over to the next test.

The foremost goal of such demonstrations is to interface users – here elderly people – and the CLARC system in order to extract useful insights for the ongoing design of the latter's prototype and to get cues about the viability of their business case. Elderly people in particular are taken here as a valuable informational resource for technologising care work (Compagna and Shire 2014). Such feedback can then lead to adjustments to the robot design but also the very conduct of the experiments themselves. For example, in the post-interview after the test one of the CLARC members reports that the patient felt insecure and uneasy in the presence of all the people standing around. As a consequence, bystanders were banished from the library for the ensuing tests and had to wait in the chapel nearby, which albeit ironic was not a moral exercise of repentance but rather a way to make the experiments run more smoothly.

7.3.2. Three critical responses

There are three more or less established positions with regard to RobotCare, which I have previously circumscribed as humanist, solutionist and anti-essentialist (see chapter 2). While the former two are mostly found within and around dominant discourses on the matter (e.g. media articles and innovation policy), the latter is mainly confined to the arenas of STS academia. These three strands enable different critical responses to RobotCare, which I will illustrate regarding the vignette described above.

For a solutionist position, a timely export of robots is deemed necessary in order to tackle the grand challenge of ageing. RobotCare is configured as mostly a technical task of engineering machines in such a way that they can become interactive and intelligent enough to interact with people. In this narrative, the realm of society and, incidentally, politics is limited to mobilising acceptance for a given device in care, since robots are generally seen as beneficial to it. This task is delegated to the entrepreneur-scientist to market and advertise a given technology in positive ways in order to convince potential users of that benefit. The herein implied linear innovation model of innovation (Godin 2006) relegates the 'participation' of society to downstream demonstrations, where test users are supposed to give feedback for final refinement, or in the form of ethical, legal, and societal (ELS) impacts. The latter can lead to particular ethical requirements for research (e.g. consent by elderly people) or the adaptation of legal frameworks managing risk in the deployment of robots. Hence, such a position would hold that elderly (test) users should not come to harm and measures must be taken in order to prevent that from happening. The above mentioned adaptations, removing distracting bystanders or altering instructions, conform to such a solutionist critique. Elderly people denote a valuable resource for interfacing robotics and care, and must thus be catered to accordingly.

For a humanist position, the introduction of robots into care denotes a (potential) violation of the integrity of care, since this domain is deemed to be about essentially human qualities, which robots can at best emulate. Robots are essentially seen as incompatible with the core of what care work means, e.g. emotional investment, genuine interest in the other, and the ability to empathise with them. Applying robots to such human parts of care is thus only possible at the expense of that humanity. Additionally, robots are seen as being guided by and enforcing goals foreign to care work. Robotics' narrative of saving costs and making care more efficient is countered with the argument that this would only be possible at the expense of the inherently non-economical, altruistic logic of care. Technology is thus allowed solely to subsidiary, assistive tasks within care, for example, the collection of patient data in the course of geriatric assessment. As a consequence, care is deemed as not being able to contribute to the development of technology. The task that remains is to safeguard 'human' care from the 'inhumane' grasp of (robot) technology. In this vein, the above incidence denotes an, albeit expected, *skandalon* of care work. The robot together with the bystanders dehumanise the elderly person by not attending to its needs or emotional situation. Even the doctor could be seen as temporarily suspending his caring role, interested only by the envisioned saving of time that robotics promises him.

Finally, an anti-essentialist position would refute both of those positions arguing first of all that they are based on wrong assumptions about care and robotics altogether. In its most radical form, such a position would contend that there is no primordial essence to either robotics or care but would rather take them

> "as contingently stabilized through particular, more and less durable, arrangements whose reiteration and/or reconfiguration is the cultural and political project of design in which we are all continuously implicated." (Suchman 2007, pp. 285–286)

Both robotics and care thus denote temporarily stabilised *socio-technical arrangements*, where the retreat to either purely human or robotic qualities is nonsensical. On one hand, robots are infused with social qualities, with stereotypes about elderly people, assumptions about 'the social', and political narratives. On other hand, care work is pervaded with all sorts of (digital) technologies, professional routines, and scientific knowledge. Such a position would point to the socio-technical arrangements underlying such practices instead of retreating to their indubitable essences. For example, the situation described above would configure the elderly person not as an active part of development but rather as a passive resource for the ongoing development of robot technology. This materialises an ageist and technologically determinist 'script' of robot technology. Such a perspective could point to the failure of such an inscription (Akrich 1992) and problematise the ensuing adjustments as implicitly blaming the user for not following that script (Woolgar 1991).

So while humanist and solutionist positions are based on essentialist notions of robotics and care thus denying (or at least underestimate) the socio-technical interconnectedness of both domains, the anti-essentialist position of STS asserts the world as already intimately interconnected. The latter's critique mainly derives its critical verve from deconstructing the distinct categories rallied by those domains against supposed (ethical) transgressions.

7.3.3. A critique of critiques: towards a critique of techno-politics

While I have in part based my own study on this last position, I have also sought to expand respectively refine it. At the heart of this project lies the puzzle or restraint to neither take robotics and elderly care as strictly separated nor as already interconnected but rather to orient the analytical attention towards the manifold practices and milieus, through which the interconnection of RobotCare has come into being in the first place. Hence, in reading together my own critical project pursued throughout this study with the critical responses described above, an interesting challenge arises: is a critique of technology possible that neither takes for granted nor negates socio-technical interconnectedness? Ultimately, what kind of critical attitude is enabled by an analytics of interfacing?

Paradoxically, such a critical project places itself in between the essentialist and anti-essentialist positions. What does that mean? First, it means that the assertion of 'differences' respectively 'essences' denotes the pre-condition or by-product of interfacing processes. Interfacing analytically implies to dissect what should be rendered available for one another. To talk about human-robot interaction implies the difference between human and robot, to talk about societal impacts implies the difference between agential technology and a passive society, and being interested in a recording device for automating geriatric assessment implies a certain hierarchy between different forms of care work. As Karen Barad argues, the instantiation of boundaries matters not as obstructing an already interconnected world but rather in creating that world altogether (Barad 1998). Hence, critique cannot simply rely on deconstructing such boundaries but rather must evaluate and investigate their world-making effects. In this vein, the present book has pointed to particular conditions and modes, which have been instrumental in creating the reality of RobotCare in different ways and within different contexts. While practices and milieus of interfacing can be extremely precarious and constantly shifting, those modes are not at all instable (nor are they inherently stable of course). Their power precisely becomes comprehensible when considering their stabilising force *vis-à-vis* the overarching concern of rendering robotics and elderly care, technology and society available for one another.

Second, an analytics of interfacing shows how the socio-technical interconnectedness of the world is not a given but rather the effect of a particular techno-political regime, which *produces* the world as interconnectable. Hence, in order to analyse and consequently criticise the phenomenon of RobotCare it does not suffice to reconstruct the underlying socio-technical interconnectedness but rather to identify how the regime enabling its emergence has conditioned the interconnectability of robotics and elderly care in the first place. Furthermore, the way, in which European innovation politics seeks to interconnect these domains, differs from and hence is specific to previous interconnections of technology and society. This is to say that of course robotics is not the first technological project, in which care is involved or targeted. Enclosing the elderly in almshouses or registering them through social surveys also denote efforts to invest particular technologies in (bio)politics within the context of an alarmist demography (Katz 1992). The difference is that while in that case such technologies are inscribed with the aim to seclude and discipline old age (Katz 1996), RobotCare frames the relationship between robot technology and elderly care in (economically) productive terms, that is, in terms of technological innovation. It hence relies on a different rationality of interconnectability, where the technology and politics interconnect within a techno-political regime that prioritises economic benefits over others, innovation over conservation, assistance over care, growth over subsistence, high-tech over low-tech and so on. Hence again, it is the particular modes of how robotics and care become interfaced, which allow for critical avenues into the phenomenon of RobotCare and, beyond that, a techno-politics of innovation. It would thus render critique blunt to consider socio-technical interconnectedness as a basic analytical presupposition instead of the historically contingent product of a particular techno-political regime.

This middle position focuses on milieus and practices of interfacing as the paramount vehicle for critical enquiry. Such a form of critique consists in investigating and questioning the ostensibly self-evident rationalities of interconnection, which inform assumptions about the socio-technical interconnectability of the world. The foremost task would therefore not be to either safeguard care against robotics or simply facilitate their timely interconnection. Rather, critique can be defined as the persistent task to unravel the modes and conditions, on which such endeavours rely, as well as the impositions, with which they confront the elements that they produce and interconnect. Its central objective would not consist in either the defence against an ongoing process of technologisation or in the uncritical, distanced assessment of such processes. Rather in light of an extensive techno-political problematisation, the primary concern of such a critique lies in fathoming *alternative* modes of interfacing robotics and care, technology and society.

To speak once again with Foucault, a critique of techno-politics might after all be defined as *the persistent task of not being interfaced like that and at that cost* (after Foucault 1997a, p. 29).

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