S|S|S

Social Studies of Science
42(1) 121–142

DOI: 10.1177/0306312711431817
sss.sagepub.com
SAGE

How places matter: Telecare technologies and the changing spatial dimensions of healthcare

Nelly Oudshoorn
Department of Science, Technology and Policy Studies, University of Twente, Enschede, the Netherlands

Abstract

Dominant discourses on telecare technologies often celebrate the erasure of distance and place. This paper provides a critical intervention into these discourses by investigating how spaces still matter, despite the move from physical to virtual encounters between healthcare professionals and patients. I argue that science and technology studies (STS) research on telecare, as well as other technologies, can be enriched by including a focus on place to understand the dynamic interactions between people and things. Adopting insights of human geographers, I show how places in which technologies are used affect how technologies enable or constrain human actions and identities. Whereas some spaces may facilitate the incorporation of technologies, others may resist technologies. A focus on how places matter is important for understanding how telecare technologies reorder and redefine healthcare. Although other healthcare technologies are also important actors in transforming healthcare, telecare technologies do this in a very specific way: they redefine the spatial dimensions of healthcare. To capture and further explore this changing spatial configuration of healthcare, I introduce the notion of technogeography of care. This concept provides a useful heuristic to study how places matter in healthcare. Although telecare technologies introduce virtual encounters between healthcare providers and patients, the use of telecare devices still largely depends on locally grounded, situated care acts. Based on interviews with users of several cardiac telecare applications, including healthcare professionals and patients in Germany and the Netherlands, the paper shows how patients' homes and public spaces are important for shaping the implementation and use of telecare technologies, and vice versa. Last, but not least, telecare devices are implicated as well. The paper emphasizes the place-dependency of the use and meaning of technical devices by showing how the same technological device can do and mean different things in different places.

Corresponding author:
Nelly Oudshoorn, Department of Science, Technology and Policy Studies, University of Twente, P.O. Box 217, 7500 AE, Enschede, the Netherlands.
Email: n.e.j.oudshoorn@utwente.nl

Keywords
spatial dimensions of healthcare, telecare technologies, user-technology relations

In the last decade, the healthcare sector in modern societies has witnessed the testing and introduction of an increasing number of telecare devices aimed at monitoring and diagnosing a variety of chronic diseases at a distance. Patients who suffer from diabetes, respiratory disorders or heart disease do not have to visit their doctor so frequently anymore, because healthcare activities are mediated by various wireless information and communication technologies (ICT) devices, such as devices that monitor blood sugar or blood pressure, electronic scales that monitor weight change, and mobile ECG monitors that detect heart rhythm disturbances. The introduction of these new technological devices has major consequences for healthcare: they redefine the spatial dimensions of healthcare by (re)distributing care over multiple actors and locations. Although dispersal of care can be observed in current healthcare practices, telecare technologies introduce a situation in which care is not only distributed to different locations and actors, but also is simultaneously reconnected to them by ICTs. Telecare technologies constitute a transformation of healthcare because they create networks in a literal, material sense: actors and places are connected by various technologies that operate via copper wires, glass fibres and satellites. Consequently, telecare technologies introduce very explicit and forceful scripts for collaboration and interdependencies.

The most crucial way in which telecare technologies affect the spatial dimensions of healthcare is that actions such as diagnosis and monitoring take place when healthcare providers and patients are not in the same place. Unlike other technology-mediated healthcare practices, telecare is integral to geographical distance. Telecare technologies constitute a spatial separation between healthcare professionals and patients in which physical contacts are replaced by virtual encounters. Although virtual interactions seem to be central to this new healthcare technology, we may wonder what happens to the physical spaces in which healthcare is situated. Since the emergence of ICTs, particularly the Internet, advocates of these new technologies as well as academic scholars have emphasized and celebrated the erasure of distance and place by global networks and the free flow of information and people (Cairncross, 1997; Kolko, 2000). Like discussions about the Internet, discourses on telecare also tend to ignore place. As Maggie Mort and her colleagues have described, telecare technologies have been framed in terms of 'flow, transmission and mobility' (Mort et al., 2009: 10). Producers and other proponents of telecare technologies portray these innovations as tools that provide care-at-a-distance without specifying the places involved. Such representations, articulated in promises on websites of telecare firms, seem to suggest that the locations at which care takes place are no longer relevant. When addressed at all, sites such as the home are presented as 'tabula rasa' in which telecare devices can be introduced unproblematically (Oudshoorn, 2011). In this paper I will argue that places still matter in telemediated healthcare, despite the move from physical to virtual encounters between healthcare professionals and patients. The paper is structured as follows. It begins with a discussion of relevant studies of the importance of place by scholars in the fields of human geography and science and technology studies. I then introduce a technogeographical approach to studying user-technology relations. This is followed by a section on methods and two sections in which I present

my analysis of how specific telecare devices participate in transforming domestic and public spaces. In the conclusion, I reflect on the major findings of this study and the technogeographical approach developed in this paper.

The importance of place

To understand how telecare technologies participate in changing the spatial dimensions of healthcare, I suggest it is important to incorporate insights developed in human geography. This field of expertise recognizes the importance of place in defining human relationships. Geographers understand place as a site of social relations: 'places are not just physical but also involve situated human intention with them' (Andrews, 2003). Like science and technology studies, geography goes beyond deterministic views by emphasizing that people and places are mutually constitutive (McKeever, 2001: 4). Places act as sites of social relations, and human relationships have spatial aspects: 'our proximity to or distance from others and from places have meaning for us' (Malone, 2003: 2317). The view that places matter has also been adopted and further elaborated by scholars in the field of health and human geography to emphasize 'the emplaced nature' of healthcare (Milligan, 2009: 6; also see Milligan, 2001). According to Christine Milligan, healthcare should be understood within a 'relational framework' in which practices of caregivers and care-recipients are investigated in relation to the places in which care takes place (Milligan et al., 2007:135). This scholarship has been very important for drawing attention to contemporary changes in the institutional spaces in healthcare, particularly the shift to community-based care and the redistribution of care from the state and formal caregivers to informal caregivers such as voluntary organizations and the family, due to welfare state reforms in advanced industrialized countries in the past two decades. This shifting landscape of care, often referred to as 'extitutionalization', requires a rethinking of the distinctions between formal and informal care practices that take place in institutional spaces such as the hospital, the community and the home (Milligan, 2009: 23; Mort et al., 2009: 11).[1] As Pascale Lehoux and her colleagues have argued, the very places in which care takes place shape how informal and formal caregivers 'define their technical, moral, and professional duties, and how they behave' (Lehoux et al., 2004: 644).

Although this scholarship provides important insights into the relationships between people, place and care, the role of technology in the changing landscape of healthcare has been neglected for a long time. Lisa Cartwright was one of the first to study the relationships between place, care and technology. In her study of telemedicine in the US and Canada, she argued that telemedical technologies introduce a 'new geography of local and global health promotion management' (Cartwright, 2000: 348). Cartwright showed how telemedicine constitutes new configurations of community identity and populations, including new definitions of remote peoples. Whereas Cartwright refers to geography of care to describe how telemedicine affects populations, more recent studies employ a geographical approach to study the local telecare practices and lived experiences of individual caregivers and care-recipients. Maggie Mort, Celia Roberts, Christine Milligan and Daniel Lopez, for example, focused on telecare and domestic technologies developed for frail, elderly people in order to understand how these new care technologies

contribute to what counts as care, and also how they reallocate care to the domestic home, introduce new responsibilities and new actors, and create new meanings of 'ageing in place' (Lopez, 2010; Milligan, 2009; Mort et al., 2008, 2009; Roberts and Mort, 2009).

To capture and further explore the role of technology in changing the spatial configuration of healthcare, I introduce the notion of technogeography of care. I use this notion to refer to two intertwined processes involved in changing the relationships between people, places, care and technology.[2] First, it refers to the ways in which technologies participate in changing the landscape of care by connecting previously distinct places, redefining the meaning of these places, and creating new sites where care takes place. Second, inspired by Madeleine Akrich's (1992) notion of geography of responsibilities, I refer to how technologies contribute to creating interdependencies and distributing responsibilities between people, places and technical devices, thus reconfiguring who cares.

Whereas geographers argue that we should be sensitive to places, science and technology studies (STS) scholars emphasize the importance of paying attention to how technologies incorporate scripts that produce specific geographies of responsibility by delegating tasks and responsibilities to humans and technical devices (Akrich, 1992). Although scripts of technology may be important in pre-structuring human actions, adopting the insights of human geographers, we should be aware that places are important as well. Places are not only important because assumptions about the contexts of use are inscribed in technologies, as Akrich has argued.[3] They also matter because places shape how technological devices are used, or not, and (de)stabilize the specific identities of technologies. Equally important, technologies participate in redefining the meaning and practices of the spaces in which they are used and, as I will show, introduce new spaces in which people and objects interact. The idea that places matter thus provides an important point of departure for an investigation of how reciprocal relationships between people, places and technologies enable or constrain the identities of users, places and technologies.

To be sure, the relevance of including place also has been articulated by several other STS scholars. This renewed interest in place is a reaction to the rather bold claim that places are no longer relevant because, due to the emergence of the Internet, we live in a 'network society' characterized by a compression of space and time (Cairncross, 1997; Castells, 2000; Harvey, 1990; Kolko, 2000). Christopher Henke and Thomas Gieryn (2007) challenged this view by describing how places still matter in science. In their criticism, they also included actor network theory (ANT) because this approach puts too much emphasis on 'the mobility or flows of heterogeneous actants through networks … thereby diminishing the apparent significance of the specific geographical places where the actants pass through or end up' (Henke and Gieryn, 2007: 354, 355). Reflecting on previous and current research in science and technology studies, they show how the very places in which scientific inquiry is situated, including laboratories, field sites and museums, shape the production of scientific knowledge and practices and contribute to the credibility of knowledge claims. 'Science has a geography', as Thomas Gieryn claimed in the late 1990s (Gieryn, 1998: 248; 2006: 5), an argument elaborated by David Livingstone in his book with the telling title *Putting Science in Its Place* (2003). The debate on the importance of place is not restricted to studies on science but also includes technologies. An exemplary study in this respect is Glen Norcliffe's (2009) attempt to

extend and refine the social construction of technology approach (SCOT) to pay more attention to the geographical settings in which technological innovation occurs. Reflecting on these studies we can conclude that they primarily focus on the production of scientific knowledge and technological artefacts. As such, this body of literature thus reflects a tendency in STS to prioritize production over use, a position that has long been criticized by many scholars (Oudshoorn and Pinch, 2003, 2007). The broader aim of this paper is therefore to contribute to this ongoing debate on the importance of place by including use practices of technology in the analysis.

Methods

To understand how telecare technologies participate in changing the spatial dimensions of healthcare, I selected two devices currently used in the US and several European countries: a telecare system for heart-failure patients and an ambulatory ECG recorder to diagnose heart-rhythm irregularities at a distance. Technologies to monitor heart failure at a distance are a very recent innovation. In the US, the first telemonitoring system was put on the market in 2006; one year later the same technology was introduced in the Netherlands and clinical studies were initiated in Germany. This new telecare technology was developed and introduced by Philips, one of the largest electronics companies in the world, with market leadership positions in diagnostic imaging and patient telecare technologies, as well as electronic consumer technologies such as televisions. The telemonitoring system for heart failure, called Motiva, is the company's first telecare system. It consists of wireless devices for the daily measurement of weight and blood pressure.[4] These measurements, collected by patients at home, are automatically sent to a telemedical centre (the Netherlands) or a hospital (the US). In case of deviating measurements, the telemonitoring system gives a signal to nurses who phone patients to ask them why their weight and blood pressure are not within the expected ranges (Balk et al., 2007: 56).

The ambulatory ECG recorder was introduced in the Netherlands and Germany in 1995 by Hartis BV, a small Dutch company that runs a telemedical centre in Amsterdam. The device consists of a round box that patients can clip to their waistbands, with three ECG electrodes that they have to attach to their bare chests. When patients experience heart-rhythm problems, they are expected to produce one or more ECG recordings and call the telemedical centre, where a telecare worker reads the ECGs and gives the patient feedback. If there is an emergency, the telephysician will call for an ambulance and inform the patient's general practitioner.

This paper is based on interviews with healthcare professionals and patients, as well as questionnaires given to the latter. For the analysis of practices using the ambulatory ECG recorder, interviews were held with two physicians at the telemedical centre in Amsterdam, two nurses of a home-care office responsible for handing out ambulatory ECG recorders and giving instructions to patients, and two general practitioners who prescribed ECG recorders. In April and May 2004, a total of 95 patients made use of the telemonitoring system that we studied. Semi-structured, in-depth interviews were held with eleven of these patients. The remaining patients in the population received a questionnaire, 54 of which were returned. The analysis of practices using the heart-failure monitoring system is based on an empirical study conducted between December 2005 and November 2007. The study included in-depth interviews and observations of five

heart-failure patients who used a telemonitoring system for 1 year as part of a clinical trial, and five patients who refused to participate in this trial. Both users and non-users represented a variety of backgrounds in terms of demographics, disease history, and experience with and attitude towards ICT devices.[5]

By focusing on use and non-use, this paper aims to contribute to the growing literature on user-technology relations. Non-users have drawn considerably less attention than users in STS, with a few notable exceptions (Kline, 2003; Kline and Pinch, 1996; Wyatt, 2003; Wyatt et al., 2002). This neglect of non-users is not innocent. By focusing almost exclusively on users, we may implicitly reinforce what Everett Rogers has called the 'pro-innovation bias', a view of technology that suggests that 'an innovation should be diffused and adopted by all members of a social system' (Rogers, 2003: 25). A focus on non-users of telecare technologies seems to be even more urgent than investigating non-use of consumer technologies – technologies often analysed in user research in cultural and media studies. A decision to resist a new technology may be more consequential when it concerns health rather than leisure or other forms of consumption. This article will therefore address the perspectives and care practices of users as well as non-users of telecare devices.

Reconfiguring the home: Inspecting bodies and coping with disease

> Home is not a Machine, Home is for People. Home is an emotionally charged and personally furnished cradle of living – physical space as much as social–cultural context and a state of mind. (Friedewald and Da Costa, 2003: 18)

One of the promises of telecare technologies is that healthcare will partly move from the hospital to the home. These novel technologies thus follow the path of home-care technologies by taking diagnostic and monitoring procedures outside the hospital and bringing them into patients' homes. Research on how home-care technologies affect patients' homes suggests that telecare technologies may also play an important role in redefining the home.[6] Studies of high-tech home-care technologies have shown how receiving long-term healthcare at home changes 'the meanings and the experience of being "at home" and "in place"' (Angus et al., 2005: 164; Lehoux et al., 2004; Willems, 2008, 2010). As Christine Milligan has argued, the 'reordering of the home into a space of care' involves a continuous renegotiation of the meaning of home as a site of care and a place of social relations and personal life (Milligan, 2009: 71, 72). Angus and colleagues (2005) explained these changes in terms of conflicts between the aesthetics and logics of healthcare and the home. The ambience of the home is affected by the intrusion of technological objects unfamiliar to the private space of home[7] (Arras and Neveloff Dubler, 1995; Lehoux et al., 2004). Telecare technologies drastically extend this 'medicalization of the home' (Arras and Neveloff Dubler, 1995: 3), because they introduce medical devices for monitoring and diagnosing chronic diseases that occur frequently in western industrialized countries, including diabetes, respiratory insufficiency and heart disease. Telecare technologies not only extend the medicalization of the home to a broader population, they also introduce another configuration of care. Whereas home-care technologies consisting of stand-alone

medical devices, such as home oxygen dispensers or sophisticated catheters and infusion pumps, require skilled nurses who pay regular visits to patients' homes to instruct and monitor patients and their informal caregivers (Arras and Neveloff Dubler, 1995: 3), telecare technologies delegate the responsibility for monitoring to patients. Telecare devices are expected to be used at home or in other non-clinical spaces without the presence or assistance of nurses. A second important difference with home-care technologies is that telecare technologies can be used to extract information electronically from the home, which redefines the notion of home as a private, physical space. Telecare technologies, and the healthcare professionals that evaluate and process data generated from their use, thus enter a place that has traditionally been protected against public officials and governmental services interfering with private family life (Brown and Webster, 2004: 85).

Although we should be careful to avoid too romantic a view of the home, human geographers emphasize that the home should not be considered as a tabula rasa, a merely physical space. Instead they suggest that homes should be considered as sites of social relations and personal meanings, historically and culturally specific spaces that contribute to shaping people's identities (Angus et al., 2005; Arras and Neveloff Dubler, 1995; Friedewald and Da Costa, 2003). As geographical research on home-based care for frail, elderly people indicates, the shift towards care at home reconfigures the home by changing how people identify with the home and shaping the power relations between informal and formal caregivers, as well as gender relations (Milligan, 2009: 23). Feminist scholarship in this field has demonstrated how care has been constructed as a predominantly female activity and responsibility, a pattern which may be reinforced by the shift of care to the home. Equally important, homes may be experienced differently by women and men (McDowell, 1999; Milligan, 2009). Based on these insights, we may expect that telecare devices cannot simply be inserted into the home without changing the experience and meaning of home, including the gendered social relationships of its inhabitants.

Although human geography thus provides an important perspective on the home, as the above quotation suggests a dualism between home and machine does not seem adequate. Homes are not constituted only by people. Quite to the contrary, in our technological culture, homes are increasingly populated by technical devices. When a technogeographical approach to home and technologies is adopted, technical devices can be viewed as new 'inhabitants' of the home. Thus we may wonder how these newcomers will affect the home. In contrast to other technological inhabitants, such as high-tech home-care technologies, telecare technologies may not be highly visible. Whereas high-tech home-care devices often bring about substantial changes in the home (an oxygen machine may turn a living room into a bedroom), telecare devices seem less intrusive at first glance. Satellites and broadband connections are literally invisible. Electronic blood pressure meters, scales and ECG recording devices can easily be stored in the bedroom. The TV and phone on which telecare devices often rely are already familiar technologies in the home. This does not imply, however, that these technologies are less important for changing the meaning, practices and experiences of home. As Mort et al. (2008) have described for telecare technologies for disabled people, such new technologies can be experienced as unwelcome intruders in the home, even when they do not drastically disrupt the physical space of home. So what sort of home is constituted when the homes of patients are electronically connected to healthcare organizations?

Transforming the home into an electronic outpost clinic

Flashing lights and talking scales: How homes get wired to healthcare organizations

The first change patients experience when they agree to use the heart-failure telemonitoring device is that technicians visit their homes to install a broadband connection. This electronic hardware is required to transfer data between patients and the telemedical centre. As described in the methods section, patients are expected to measure their weight and blood pressure daily by using a wireless automated scale and blood pressure meter. The broadband connection, together with a so-called set-top box (a small, rectangular grey box), supports the transmission of these measurement data between patients' homes and the telemedical centre. A connection between a patient's TV and the Internet mediates the communication between the patient and healthcare providers at the telemedical centre. The patient's home thus becomes inhabited by various electronic devices, which have to find a place in the household. The set-top box is usually installed near the TV in the living room, whereas the electronic scale and the blood pressure meter are put in the bedroom (observations in patients' homes, 2006).

So, how do these technological inhabitants 'behave' in their new environments? The set-top box has a very active presence in the room. When the telemedical centre sends a message to the patient's home, the box gives an orange light signal to notify the patient that the telemedical centre has received the measurement data, which he or she can view on a video channel of the TV set in the form of graphs, representing the data over a period of 30 days. The set-top box also gives a flashing signal to tell patients that they should watch educational videos on diet or exercises for heart failure, or fill in a questionnaire. If the patient does not read the message within a day (telenurses can see in the system whether the patient has opened the message), they receive a phone call from the telemedical centre and the signal will keep flashing. Although less visible than the set-top box, the TV also provides a new element in the living room. Whereas the TV set was introduced in the home as a technology for entertainment or information, the wireless connection of a patient's home to a telemedical centre transforms the familiar technology into a personal healthcare device. Instead of watching the news, movies, or other entertainment programmes, a patient can watch graphs representing diagnostic markers of their health condition, look at educational videos, or read messages from telenurses. Finally, the introduction of the electronic scale in the bedroom also draws attention. It is larger than other scales, because it is placed in a metal frame that helps the patient to stand still while using it. Moreover, the electronic scale can talk! As we shall see below, this intriguing feature invites unintended interactions with family members visiting patients' homes.

During the interviews we learned that patients worked to domesticate the new inhabitants of their home: the set-top box, the electronic scale and the novel functions of the TV set. As Silverstone and colleagues have described, showing a new technology to your family or friends, a process they called conversion, is an important aspect of 'taming' technologies (Silverstone et al., 1992). Two features of the telemonitoring system turned out to be very helpful in this process. First, the fact that graphs of patients' weight and

blood pressure measurements could be viewed on TV enabled patients to show them to visiting family members or friends. Because the TV and the set-top box were situated in the living room, patients often showed them to visitors, who sometimes were curious about the 'small box near the TV' and wanted to see the graphs.[8] Although many visitors often were impressed with the new technology, particularly with the fact that it was wireless and that measurements sent from it were transferred to another city (Zwolle: the location of the telemedical centre) before appearing on the TV screen, others were rather critical. For example, the son-in-law of one of the patients, who happened to be a physician, considered the system as too much of a burden for the patient (interview, male patient, age 74 years).

Another feature of the telemonitoring system that attracted attention from visitors, particularly children, was the electronic scale. The scale not only showed the measured weight on a display but also emitted a voice that instructed the patient to stand still for a moment. After a while the voice continued with 'You can step off the scale now', and 'Your weight will be shown in kilograms'. The grandchildren of one of the patients were so fascinated by the talking scale that they wanted to use it whenever they stayed with their grandparents. Their grandfather tried to stop them, because the data were sent automatically to the telemedical centre (interview, male patient, age 70 years). The introduction of telecare devices in the home thus changed the experience of the home, both for visitors and family. The new devices created an environment in which watching health messages on TV, playing with electronic scales and discussing the (dis)advantages of telecare devices became part of routines with visitors. Consequently, the heart problems of the users became a more active theme in their homes.

Reorganizing home-time and disciplining bodies

The introduction of telecare devices in the home not only shapes the visitors' and families' experience of patients' homes, it first and foremost changes the experience of patients themselves. As soon as the telecare system is installed, patients are expected to integrate its use into their daily routines. They soon learn that being at home is no longer what it used to be prior to the entrance of new technical inhabitants. The new technology is not just another home appliance. The telecare device introduces a technogeographical configuration of care in which the home is transformed into a place where patients are made responsible for monitoring their own bodies. Consequently, patients are expected to become disciplined in order to monitor their bodies. A first step in this process is that patients are expected to observe very precise schedules. Each morning they have to measure their weight on the electronic scale and take their blood pressure. Patients showed us how they had integrated the use of the devices into their daily routines. In order not to forget to take the measurements, most patients installed the electronic scale and blood pressure meter in their bedrooms, so that they were reminded to measure their weight and blood pressure when they woke up in the morning. Because they were instructed to take measurements when their bodies were still relaxed and not yet stressed by too much physical movement, they developed the routine to measure their weight and blood pressure before or shortly after breakfast. Consequently, the morning is broken down into rather fixed time sequences: wake-up, get out of bed, wash yourself, measure your

weight and blood pressure, breakfast. Although the order of the last three activities can vary from patient to patient, the use of the heart-failure system introduces a new element into mornings spent at home.

The telemonitoring device not only structures the early parts of the day. The flashing light of the set-top box and the phone calls of the telemedical centre require the full attention of the patient throughout the day. Patients are expected to switch on their TV sets as soon as the set-top box gives an orange signal that invites them to look at specific messages. Moreover, patients also have to answer phone calls from telenurses. As described in the methods section, the telemonitoring system sends patients and telenurses messages when it detects deviant measurements. When receiving such signals, nurses phone patients to inquire about the changes in weight or blood pressure, and they may then ask the clinic to change the patient's medication. Such all-day monitoring contradicts the promises made by the producer, who suggested that 'patients only have to spend a few minutes each day at their convenience interacting with Motiva' (Philips Press Information, 8 May 2006). The use of the telecare device definitely takes more than just a few minutes, and patients are not free to choose when to take their measurements or to interact with the telemedical centre. Consequently, the device requires that patients remain at home all day, and its 'script' thus assumes that patients are homebound. This may be the case for elderly patients who suffer from severe heart disease, but not necessarily for others with a milder forms of the disease.

The technology thus requires an immediate form of presence that can best be described as an asymmetrical tele-co-presence. Following Goffman's (1959) notion of co-presence, which referred to physical proximity in social interaction, Zhao (2005) has described social interactions mediated by ICTs as tele-co-presence. In many ICT applications, such as mobile phones and the Internet, this digital co-presence is symmetrical. In the case of telecare technologies, however, it is asymmetrical: patients are always accessible, available, and subject to the monitoring of the healthcare professional, whereas the professional is not directly available to the patient. Although patients sometimes call the telemedical centre, they are not encouraged to do this. The technological script implies that telenurses may call patients in the case of deviant measurements but not vice versa. This asymmetry also involves weekly schedules. Whereas patients are expected to send their data 7 days a week, the telemedical centre operates only on weekdays (interview, telephysician). A patient told us that he had received a phone call from the telenurses on a Monday when he had forgotten to send his data that Sunday (interview, male patient, age 74 years). Some users were very disappointed by this restricted surveillance, because they often had heart-failure problems during the weekend, when it was harder for them to adhere to the diet regimen at dinners they enjoyed with family or friends (interview, male patient 1, age 70 years). In case of problems during weekends, patients have to rely on their family doctors (who often do not want to interfere in the care trajectory) or, in emergencies, visit the hospital (interviews, male patient 1, age 70 years, and male patient 2, age 70 years).

To summarize, we can say that the use of the heart-failure monitoring system requires the immediate presence and agency of patients. Patients are expected to use telecare devices at specific moments of the day and to be available for feedback by telenurses all day. The script of this telecare device thus turns its use into a compulsory rather than a

voluntary act. As I described elsewhere, the telecare device for heart-failure patients transforms self-care into an obligation (Oudshoorn, 2009). The new technology forces patients to comply with the guidelines for medication, diet and exercise; otherwise, nurses will correct them immediately based on the 'flags' nurses receive on their computer screens when patients exceed the set standards for weight and blood pressure. The introduction of telecare technologies into the home thus transforms patients into 'assistant medical personnel', who actively participate in monitoring their own bodies (Langstrup Nielsen, 2003: 16).

Redefining gender relations in the home

The technogeographical configuration in which the monitoring of bodies is delegated to patients at home not only affects patients. Other inhabitants of the home, usually the patients' partners, are also involved in the daily inspection of bodies. We became aware of this during our interviews and observations at patients' homes. Initially, our main interest concerned the patient, but soon we learned that husbands or wives also played an active role in using the devices. It frequently happened that the partner, who was often present during our visit, joined in the conversation and told us very interesting things that we would not have noticed had we focused exclusively on the person expected to use the device. The telecare device thus redefines social relations in the home beyond the individual patient (also see Lehoux et al., 2004). Technologies used at home may afford or preclude specific social relations, and, as I will show, gender relations in particular. During the interviews, we learned that the telecare device enabled male partners to act as the 'owner' of the telecare devices ('I had some flashing lights under the TV') and to display their technical competence by answering questions about how the system operated before their wives, the intended users of this telecare device, could tell their stories.

The most important way in which the telecare device transforms relationships in the home is that patients' partners are turned into co-inspectors of bodies. As described above, the telecare device disciplines patients to take care of their bodies at specific times of the day, a process in which patients' partners play an important role. They often ask whether their wives or husbands have conducted the measurements, or how high or low their measurements are, and they sometimes notify their spouses when they discover the flashing light on the set-top box. Equally important, patients often watch the graphs on TV together with their partners, monitoring their weight and blood pressure measurements. This joint watching enabled them to share with their partners how successful they were in adhering to the set standards, which are displayed on the screen with a firm line representing the upper and lower limits of weight and blood pressure. Again, there is a specific gender dynamics at work. The male partners of female patients seem to be particularly active in assisting their wives with operating the telecare system, as is exemplified by the experiences of a female patient:

> Of course I have my husband, but with the system you know that you are not standing alone. That was reassuring. When there was a message and the lights flashed, my husband always checked immediately whether it was important. (Interview, female patient, age 69 years)

The support of her husband with using the telecare system made her more confident to cope with her disease at home. In contrast, female partners are more inclined to take care of bodies rather than technical devices. For example, they supported their husbands' efforts to adhere to diet instructions aimed at avoiding salty foods. Male patients told us stories about how their spouses used the recipes provided by the telecare system's video instructions for preparing healthy meals. Most importantly, wives also assisted their husbands in coping with emotions. Male patients often shared their anxiety over the results of the measurements with their partners, as is exemplified by this male patient:

> I often look at the blood pressure and then I think: damn, it is not as it should be for a week already. Then I am rather far above the line, whereas I should be far below it. … Then I tell my wife about it and I wonder what will happen to me again that day. If I had not seen it, I would not have known it. (Interview male patient 1, age 70 years)

As Henwood et al. (2003) have described for patients searching for health information on the Internet, 'ignorance is bliss sometimes'. For this patient, close scrutiny reinforced his experiences of a failing body. He considered it as a burden to watch the messages and graphs all the time, particularly when he did not feel very well, and he relied on his wife to cope with the messages confronting him. This supporting role put considerable pressure on female partners. For some of them, the information provided by the TV increased their anxiety:

> Sometimes I consider it as too much of a burden because I worry when the measurements are too high. I begin to look for a reason immediately. I want to know who is to blame. Sometimes I think that we have been too busy. Or: 'you should not eat too much'. Then I try to find a cause, but there is not always a reason, of course. (Interview female partner of male patient, age 74 years)

The patient's wife thus considered it as her responsibility, and felt guilty when her husband failed to meet the standards set for weight. The disciplining script of the technology thus is not restricted to the patient, but also can affect partners in a very specific gendered way.

These practices with the heart-failure telemonitoring system in patients' homes illustrate how this telecare device supports gender-specific dynamics in the technogeographical configuration of care. Although the telecare system turned male as well as female partners into co-inspectors of their spouses' bodies, they adopted this role in remarkably different ways. Whereas male partners supported their wives to interact with the telecare system, female partners assisted their husbands to adhere to their diet instructions and to cope with emotions related to the results of monitoring their illness.

Protecting boundaries between home and the clinic

To understand how telecare devices take part in reconfiguring the home, we decided to include non-users as well as patients in our analysis. A focus on non-users enabled us to investigate how homes inhabited by telecare devices differed from homes in which patients relied on other healthcare resources. In our interviews with patients who rejected using the heart-failure telemonitoring system, we learned how their resistance involved a protection of boundaries between the home and the clinic: they resisted the

transformation of their homes into an electronic outpost of the clinic. To them, home was a place in which they should be free to do whatever they liked. They considered the telecare device an unwelcome intruder into the home because it disrupted their daily lives. As one male patient told us:

> I consider it as an extra burden and I do not like that because I want to be free. When I want to look for something in my study, then it is a beautiful chaos, then I do not want to measure my blood pressure in the meantime. It [taking measurements] interferes with what you planned to do. In the morning I want to read my newspaper, then I do not want to think: I should do it again. And then you have all those phone calls. It only gives you extra work. I [have] lived for 86 wonderful years, so let me live and enjoy what there is with a little bit more effort. (Interview male patient, age 86 years)

Patients not only value and defend their freedom at home, but they also resist restrictions to their mobility. As described above, the telecare technology can only be used at home and thus configures the user as homebound. If patients do not measure and send their weight and blood pressure data daily, telenurses will phone them immediately. Some patients resisted becoming homebound, and spent weekends at campsites, stayed overnight when visiting their grandchildren or friends, or took short holidays with their children when feeling well (interviews, male patients 57 and 87; heart-failure nurse A).

There was more at stake than resistance to the technology's intrusion into daily life, however. Patients also refused to use the telecare devices at home when they wanted peace of mind. As one patient told us:

> I do not want to have all that equipment in my house. That is all too much for me. I want peace of mind. That's why I said no. They wanted to give me a scale and a blood pressure meter, but I told them that I do not suffer from tightness anymore, but that I want peace. I do not want to commit myself to anything at this moment. (Interview, female patient, age 66 years)

For this patient, home is a place of contemplation, a sanctuary that is threatened by telecare devices. The experience of this female patient, and some other patients cited above, illustrates how they actively defend boundaries between home and clinic. To them, home may be where the heart is, but it is not always a place to be a heart patient. These patients experienced telecare first and foremost as devices that brought the clinic into the home, a transformation they rejected because it threatened their independence and freedom. Reminiscent of Latour's triumphal tale of Pasteur's extension of the laboratory into the farm and clinic (Latour, 1988), the extension of the clinic into the home is not always welcomed by the inhabitants of the newly colonized space.[9]

Redefining public spaces: 'Can you hear my heart beat?'

Thus far, my account of how telecare devices affect the spatial dimensions of healthcare focused on one specific place: the patient's home. However, a focus on the home does not provide sufficient understanding of how telecare devices participate in redefining the spaces in which healthcare takes place. Although many such devices, at least of the current generation, are designed to be used at home, others are meant to be used when patients are on the move. Recently, the European Commission has funded R&D projects

with such names as MobiHealth.[10] These projects examine the development of telecare systems consisting of sensors integrated in clothing, or worn on or even inside the body, that enable bio-data to be measured and sent to and from places outside the home. Telecare technologies thus participate in changing the geography of care by introducing public spaces as new sites of care. However, this new space is absent from current social science research on the uses of these technologies, which exclusively focuses on patients' homes (Langstrup Nielsen, 2003; Mort et al., 2008; Pols, 2011). In contrast, the techno-geographical approach developed in the present paper foregrounds other places in which healthcare acts are situated. Drawing lessons from social studies of the mobile phone, we may expect that the use of digital care devices in public spaces seriously affects users as well as spaces. As Cooper (2002) has described, the mobile phone played an important role in blurring the boundaries between discrete domains such as public and private places and remote and distant spaces. To capture this blurring of boundaries, he introduced the notion of 'indiscreet technologies' (Cooper, 2002: 24). Because mobile phones are by now a widely accepted and domesticated technology in many countries, it is almost taken for granted that they participate in transforming public space. In contrast, telecare devices for outdoor use are a more recent development and thus are not yet accepted in routine practice, which makes social science research even more interesting and urgent. Equally important, digital mobile health devices may even be more consequential for their users, because their use concerns health as well as communication. What happens when patients are expected to use a technology that is designed to monitor and diagnose their illness in a public place? How and to what extent do these mobile devices act as 'indiscreet technologies'?

To answer these questions, we analysed uses of the ambulatory ECG recorder, a telecare device designed to be used in public places as well as the home.[11] To detect irregularities in heart rhythms, patients are expected to carry the device with them at home and whenever they go out: in shopping centres, on public transport, in work spaces, or at the homes of friends and family. The patients we interviewed all experienced problems with using the ambulatory ECG recorder in public, particularly because of its sound script. Many new devices, particularly but not exclusively ICT products, are characterized by a lack of transparency in how they work. Designers of telecare devices often anticipate this lack of transparency by designing feedback systems to reassure users that the device is working well. In the case of the ambulatory ECG recorder, the device informs patients whenever they activate the recorder correctly that the device is storing the ECG for 3½ minutes. Moreover, patients and healthcare professionals at the telemedical centre need feedback from the machine to confirm that the ECGs have been sent and received. Designers chose sound as the medium for relaying such feedback.

Although a scripted series of beeps to invite specific actions or give feedback to users facilitates the use of the ambulatory ECG recorder, these sounds also place constraints on users. When the recorder stores an ECG it makes a very sharp, high-pitched and jarring sound.[12] An unintended consequence of this sound script is that it can attract the attention of nearby people who may wonder what is wrong with the person using it. Consequently, patients are reluctant to use the recorder outdoors. Many patients we interviewed said they experienced the sound as an undesirable transgression of boundaries between the public and the private. They were afraid that the beeping recorder made their heart

problems publicly visible, or in this case audible.[13] Sound signals designed to establish trust thus turn into a violation of patients' privacy: they threaten to disclose health problems to others beyond the medical domain and the patients' intimate circle. In this respect, the ambulatory ECG recorder is indeed an 'indiscreet technology': it has the capacity to transgress boundaries between discrete domains. Patients who do not welcome the blurring of these boundaries attempt to bypass the unintended consequences of the sound script of the ECG recorder:

> I have to go to my work by train and it is of course difficult to use it there, although it may be necessary to do it. The recorder really raises the roof. It makes an awful lot of noise. Therefore I do not use it when I am not at home. (Interview, woman, age 56 years)

> I do not like it that it makes such noise. Sometimes you really think should I make an ECG here? You walk in busy streets and you think, let me wait until I am home again. But then it is actually too late again. During the recording you hear wiew … wiew … wiew. You hear your heartbeat as it were, but pretty loud. Everybody can hear it. Therefore you do not walk at ease there anymore. If it would not make such a noise I would use it more frequently. I do not want to walk in the supermarket with such a siren. (Interview, man, age 28 years).

Such users experience the sound of the recorder as especially problematic, because the device can store ECG recordings without any intentional action to initiate it. Patients are instructed to wear the recorder at their waistband, and the record button is so sensitive that it can be activated by the slightest movement, such as bumping up against something, bending down or taking a seat, or because the record button got jammed at night. Patients became very nervous because they cannot stop the recording and must endure the sound for 2½ minutes before it stops.[14]

In principle, the problems patients faced with the recorder's sound script could have been solved with small changes in the artefact. Using light or vibration instead of sound as feedback could have been an appropriate solution, but the producer of the ambulatory recorder did not offer this option (interview, Jurgens, 16 December 2004). The responsibility to solve these problems were delegated to the patients, who had to put effort into 'repairing' the technological script. To avoid intrusive ECG signals, some patients creatively fixed the recorder to their body, for example by clipping it to a bra, carrying it in a special bag around the back of the neck or in a breast-pocket, clipping it to an elastic waistband or fixing it to the side of a waistband.[15] However, other patients failed to gain control of the ECG recorder, resulting in a selective use of the technology: they used the recorder only at home, and did not wear it during holidays, sporting events, visits, or at work.[16]

The ambulatory ECG recorder thus exemplifies how design solutions to an apparent lack of transparency can have unintended, negative consequences. The beeping sounds of this telemonitoring device turned it into a disruptive actor that made patients' heart problems apparent to others in public places. Many patients resisted this transgression of boundaries between the public and the private and decided to use the ambulatory ECG recorder only at home. Most importantly, the new technology also redefined patients' relationship to public spaces. The telecare device was part of a technogeography of care that transformed shopping malls and trains into scary spaces in which patients' failing bodies were exposed to others.

Conclusions

This article provided a critical intervention into discourses that celebrate the erasure of distance and place through the use of ICT-based devices. I argued that spaces still matter, because the very places in which telecare devices are used shape how those technologies enable or constrain human actions and identities, including relationships among people and between people and technological devices. Equally important, telecare technologies take part in redefining the spaces in which healthcare takes place. Reflecting on the technogeographical approach introduced in this paper, I conclude that this approach provides an appropriate heuristic for understanding how technology-mediated connections between places and actors change the landscape of healthcare. Conceptualizing these transformations in terms of changes in geography rather than networks (the central metaphor in material-semiotic approaches to technology, particularly actor network theory), is important for two reasons. First, a conceptualization in terms of geography enables us to take into account the place-dependency of user-technology relations. In this respect, the network metaphor is problematic because it emphasizes the flows of actants through the network rather than the significance of places where the actants are situated or pass through (Henke and Gieryn, 2007). This metaphor fails to capture how places matter in shaping user-technology relations. In contrast, the technogeographical approach emphasizes how the meaning and use of technical devices depends upon place. My analysis shows how the same technological device can do and mean different things in different places. The case of the ambulatory ECG recorder illustrates how the small device changes from a more or less handy tool for diagnosing heart-rhythm problems into a disrupter of patients' privacy whenever they leave their homes to go shopping, to go to work or to visit friends. What such a technology means and how it is used (or not!) thus depends on the places where it is meant to be used. This place-dependency of the use and meaning of the new generation of telecare devices has important consequences for their design and implementation. As mentioned above, one major focus of their design is to allow patients to use them on the move. Although designers and producers emphasize the mobility of the new generation of telecare devices, and elaborate on how these devices may improve the quality of care and quality of life, the research presented in this article tells a more complicated story. As we have seen, the use of telecare devices in public spaces complicates the lives of their users. Patients often develop careful strategies for keeping others from discovering that something is wrong with their bodies. Although the beeping sounds of electronic gadgets are commonplace in public spaces, the beeps and other feedback signals emitted by medical devices are potentially stigmatizing because they can disclose information considered private. If design strategies for mobile telecare devices do not take into account the privacy problems related to their use in public spaces, they will risk the possibility that patients will use these devices only at home, thus undermining the very aim of this new generation of telecare technologies.

Second, a focus on geography rather than network is important to draw attention to processes in which the distribution of responsibilities among users of technologies takes place between actors and places that are not equally situated or represented in discourses on healthcare. In contrast to the metaphor of a network which assumes non-hierarchical

relations between humans and technological objects, the term geography makes us sensitive to distributions of responsibilities which grant agency and power to specific actors and places while restricting or silencing the agency of others (Oudshoorn, 2011; Oudshoorn et al., 2005). The technogeographical approach enabled me to show how places rendered invisible in telecare discourses play a crucial role in shaping user-technology relations. An important place affected by the new technology is the home. My analysis shows how the home is no longer the same when it becomes electronically connected with and morally integrated into the broader network of healthcare, including telemedical centres, hospitals and general practitioners' offices. In contrast to the dominant discourses on telecare technologies, which portray patients' homes as a tabula rasa, I described how telecare devices cannot simply be inserted into the home without changing their meanings and the lived experiences of dwelling within them. Electronic blood pressure meters and wireless scales, as new inhabitants of the home, markedly change daily routines and social relationships within the home. These telecare devices transform the home from a private place into a hybrid space in which private and public spheres become closely intertwined and redefined. As Dick Willems has suggested, we may wonder 'what remains of the home as the private area *par excellence* when it takes on at least some characteristics of the hospital, an almost public space' (Willems, 2008: 63). Most importantly, this transformation of the home into an electronic outpost of the clinic was not embraced by all patients. As we have seen, some patients refused to take the clinic home.

Finally, a focus on geography rather than network not only helps to open the black box of the home as an important space in shaping user-technology relations, it is also provides an appropriate heuristic for making visible how telecare technologies affect the relationships between inhabitants of the home. My account of domestic uses of the heart-failure telemonitoring device illustrates how that device not only delegates agency to individual patients, but also involves an active role of patients' partners–to 'gaze' into their bodies–a role silenced in telecare discourses. In this respect, there are intriguing gender dynamics at play. On the one hand, telecare devices act as 'gender benders' because they participate in delegating responsibilities for taking care of health problems to both women and men. In this way, the technical device disrupts traditional gender relations in which women bear the major responsibility for healthcare work in the home, ensuring that their husbands and children take medication or adhere to special diets or a healthy lifestyle (Kuhlmann and Annandale, 2010). The introduction of the telecare system in the home can be considered a drastic intervention in this gendered division of healthcare work because the task to monitor health conditions is delegated to men as well as women. Nevertheless, some of the traditional gender relations remain firmly in place. Although the telecare devices transform both women and men into co-inspectors of their partners' bodies, both adhere to a traditional division of care work in which male partners assist their wives in using the technical device and women support their husbands in coping with emotions and adhering to diets. A technogeographical approach thus makes us sensitive to the ways in which telecare technologies participate in changing (gendered) distributions of responsibilities of care as enacted in the home.

Notes

Although for privacy reasons the heart patients who participated in this study remain anonymous, I would like to thank them for sharing their experiences with academic researchers. I am also grateful to professionals involved in the field of telecare technology for granting interviews, particularly Aggie Balk, Claudia van Dam, Hanneke Glazenburg, Judith Grooters, Sandra Harthoorn, Mathilde Helm, Tony den Hollander, Leo Holwerda, Eric Jurgens, Janneke Roukema and Anita van der Wal. Finally, I would like to thank Ivo Maathuis and Lynsey Dubbeld for conducting the interviews, and Mike Lynch and the three anonymous reviewers of *Social Studies of Science* for their valuable suggestions for revisions of the first draft of this paper. Earlier versions of some parts of this paper have been published in *Telecare Technologies and the Transformation of Healthcare* (Palgrave Macmillan, 2011) and are reproduced with permission of the publisher.

1. The concept of 'extitution' has been introduced by scholars interested in the changing landscape of healthcare. It refers to processes in which traditional institutional care arrangements are replaced by new spaces of care 'that may resemble the old institutions but which are virtual and apart from the building' (Milligan, 2009: 21). The concept has been very productive to understand shifts to community care (Milligan, 2009) and residential care homes for elderly (Schillmeijer and Domenech, 2010).
2. The choice of this term is inspired by the work of Flis Henwood and colleagues who introduced the concept of 'technobiographies' to refer to the role of technologies in people's daily lives and the implicated different techno-social relationships (Henwood et al., 2001; Kennedy, 2003).
3. Although Madeleine Akrich (1992) also emphasized the importance of place for understanding user-technology relationships, her primary interest was in how engineers anticipate and define the places in which technologies are supposed to be used. My argument about how places matter in user-technology interactions is broader because it concerns the reciprocal relationships between people, places and technologies. I am particularly interested in how places shape the use and identities of technologies, and how technologies redefine places and introduce new spaces.
4. Heart failure is the medical term used to refer to an impairment of the heart's pump function, which results in redundant fluid that impairs the expansion of the lungs. Weight is an important indicator because a sudden increase in weight may be caused by retention of fluid related to an increased dysfunction of the heart pump.
5. In terms of gender and age, the users of the telecare device for heart patients who responded to the questionnaire included patients (81% women and 20% men) with a range of ages and education levels. The interviewees consisted of five men and six women of different education levels and with ages ranging from 25 to 81 years.
6. Although the telecare devices discussed in this paper are designed to be used at home by patients with chronic conditions, other telecare technologies, such as wireless personal emergency response sensors and webcams to support communications between caregivers and care-recipients, are used in intermediate places between home and hospital such as nursing homes or assisted-living facilities. See Milligan (2009) for a discussion of how telecare technologies affect notions of home, care and ageing.
7. To be sure, it is not my intention to argue for a romanticized conception of the home as a private space free from any unwarranted intrusion, which is of course not the case in many situations. Nevertheless, telecare technologies can be conceptualized as potential intruders of the private space of home (although not all devices will do this in a similar way) because they introduce new relationships between the home and the hospital. As this paper will show, patients face a situation in which they have to negotiate the boundaries between home and the clinic.

8. To guarantee that only patients and not visitors or family members could watch the graphs, the system could only be accessed by a password (interview, telenurse).
9. I would like to thank Mike Lynch for this very relevant observation.
10. See MobiHealth Project, European Commission, Information Society Technologies Program, 2001–2006. Available at www.mobihealth.org (accessed 28 October 2011).
11. See Oudshoorn (2008) for a detailed analysis of how patients tried to master the new technology in their homes.
12. The sound, as we heard it at the telemedical centre, resembled the sound emitted from a computer modem when connected to an analogue telephone line (observation, telemedical centre, 3 September 2004). The nurses at one of the home-care offices described the sound as that of yelping cats.
13. Survey 41 and 60; interviews 5, 6, 8, 9, 10, 11.
14. Survey 6, 15, 26, 27, 37, 47, 55, 68; interview 2, 6, 10; also see (Oudshoorn, 2008).
15. Survey 6, 32, 37, 47, 55, 59; also see (Oudshoorn, 2008).
16. Survey 6, 8, 10, 41, 60; interview 5, 6, 8, 9, 10, 11.

References

Akrich M (1992) The de-scription of technical objects. In: Bijker W and Law J (eds) *Shaping Technology – Building Society: Studies in Sociotechnical Change.* Cambridge, MA, and London: MIT Press, 205–244.

Andrews GJ (2003) Locating a geography of nursing: Space, place and the progress of geographical thought. *Nursing Philosophy* 4: 231–248.

Angus J, Kontos P, Dyck I, McKeever P and Poland B (2005) The personal significance of home: Habitus and the experience of receiving long-term home care. *Sociology of Health & Illness* 27(2): 161–187.

Arras JD and Neveloff Dubler LB (1995) Introduction: Ethical and social implications of high-tech home care. In: Arras JD, Porterfield WH and Porterfield LO (eds) *Bringing the Hospital Home: Ethical and Social Implications of High-Tech Home Care.* Baltimore: The Johns Hopkins University Press, 1–31.

Balk AHMM, Leenders CM, Davidse W and Westerteicher C (2007) Personalised tele-guidance of heart failure patients. Effects of the MOTIVA interactive healthcare platform on hospital admissions, quality of life, knowledge of disease and self-care. A pilot study. *European Journal of Heart Failure* 6 (suppl): 56–57.

Brown N and Webster A (2004) *New Medical Technologies and Society: Reordering Life.* Cambridge: Polity Press.

Cairncross F (1997) *The Death of Distance: How the Communications Revolution will Change our Lives.* Cambridge, MA: Harvard Business School Press.

Cartwright L (2000) Reach out and heal someone: Telemedicine and the globalisation of healthcare. *Health* 4(3): 347–377.

Castells M (2000) *The Rise of the Network Society*, second edn. Malden, MA: Blackwell.

Cooper G (2002) The mutable mobile: Social theory in the wireless world. In: Brown B, Green G and Harper R (eds) *Wireless World: Social and Interactional Aspects of the Mobile Age*. London: Springer-Verlag: 19–31.

Friedewald M and Da Costa O (eds.) (2003) Science and technology roadmapping: Ambient intelligence in everyday life. ESTO Study. European Science and Technology Observatory. Available at: foresight.jrc.ec.europa.eu/documents/SandT_roadmapping.pdf (accessed 10 December 2011).

Gieryn G (1998) Biotechnology's private parts (and some public ones). In: Thackray A (ed.) *Private Science: Biotechnology and the Rise of the Molecular Sciences.* Philadelphia: University of Pennsylvania Press, 219–253.

Gieryn TF (2006) City as truth-spot: Laboratories and field-sites in urban studies. *Social Studies of Science* 36(1): 5–38.

Goffman E (1959) *The Presentation of the Self in Everyday Life.* New York: Doubleday.

Harvey D (1990) *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change.* Cambridge, MA: Blackwell.

Henke CR and Gieryn TF (2007) Sites of scientific practice: The enduring importance of place. In: Hacket EJ, Amsterdamska O, Lynch M and Wajcman J (eds) *Handbook of Science and Technology Studies*, third edition, Cambridge, MA: MIT Press, 353–376.

Henwood F, Kennedy H and Miller N (eds) (2001) *Cyborg Lives? Women's Technobiographies.* York: Raw Nerve Books.

Henwood F, Wyatt S, Hart A and Smith J (2003) Ignorance is bliss sometimes: Constraints on the emergence of the 'informed patient' in the changing landscapes of health information. *Sociology of Health & Illness* 25(6): 589–607.

Kennedy H (2003) Technobiography: Researching lives, online and off. *Biography* 26(1): 120–139.

Kline R (2003) Resisting consumer technology in rural America: The telephone and electrification. In: Oudshoorn N and Pinch TJ (eds) *How Users Matter: The Co-construction of Users and Technology.* Cambridge, MA and London: MIT Press, 51–69.

Kline R and Pinch T (1996) Users as agents of technological change: The social construction of the automobile in the rural United States. *Technology and Culture* 37(4): 763–795.

Kolko J (2000) The death of cities? the death of distance? Evidence from the geography of commercial internet usage. In: Vogelsang J and Compaine BM (eds) *The Internet Upheaval: Raising Questions, Seeking Answers in Communications Policy*. Cambridge, MA and London: MIT Press, 73–97.

Kuhlmann E and Annandale E (eds) (2010) *The Palgrave Handbook of Gender and Healthcare*. Basingstoke: Palgrave Macmillan.

Latour B (1988) *The Pasteurization of France.* Cambridge, MA: Harvard University Press.

Langstrup Nielsen H (2003) Self-monitoring: IT and the construction of the competent patient. *Papers in Organization* 50: Copenhagen Business School.

Lehoux P, Saint-Arnaud J and Richard L (2004) The use of technology at home: What patient manuals say and sell vs. what patients face and fear. *Sociology of Health & Illness* 5: 617–644.

Livingstone DN (2003) *Putting Science in its Place: Geographies of Scientific Knowledge.* Chicago: University of Chicago Press.

Lopez D (2010) Exploring the affordances of telecare-related technologies in the home. In: Schillmeijer M and Domenech M (eds) *New Technologies and Emerging Spaces of Care*. Surrey and Burlington: Ashgate, 39–57.

McDowell L (1999) *Gender, Identity and Place: Understanding Feminist Geographies.* University of Minnesota Press.

McKeever P (2001) Home care in Canada: Housing matters. *Canadian Journal of Nursing Research* 33(2): 3–4.

Malone RE (2003) Distal nursing. *Social Science & Medicine* 56: 2317–2326.

Milligan C (2001) *Geographies of Care: Space, Place and the Voluntary Sector.* Aldershot: Ashgate.

Milligan C (2009) *There's No Place Like Home: Place and Care in an Ageing Society.* Aldershot: Ashgate.

Milligan C, Atkinson S, Skinner M and Wiles J (2007) Geographies of care – a critical commentary. *New Zealander Geographer* 63(2): 135–140.

Mort M, Finch T and May C (2009) Making and unmaking telepatients: Identity and governance in new health technologies. *Science, Technology, & Human Values* 34(1): 9–33.

Mort M, Milligan C, Roberts C and Moser I (2008) *Ageing, Technology and Home Care: New Actors, New Responsibilities.* Paris: Presses de l'Ecole des Mines.

Mort M, Roberts C and Milligan C (eds) (2009) Ageing, technology and the home: A critical project. *ALTER, European Journal of Disability* 3: 85–89.

Norcliffe G (2009) G-COT. The geographical construction of technology. *Science, Technology, & Human Values* 34(4): 449–475.

Oudshoorn N (2008) Diagnosis at a distance: The invisible work of patients and health-care professionals in cardiac telemonitoring technologies. *Sociology of Health & Illness* 30(2): 272–288.

Oudshoorn N (2009) Physical and digital proximity: Emerging ways of health care in face-to-face and telemonitoring of heart-failure patients. *Sociology of Health & Illness* 31(3): 390–405.

Oudshoorn N (2011) *Telecare Technologies and the Transformation of Health Care.* Houndmills, Basingstoke, New York: Palgrave Macmillan,

Oudshoorn N, Brouns M and Van Oost E (2005) Diversity and distributed agency in the design and use of medical video-communication technologies. In: Harbers H (ed.) *Inside the Politics of Technology.* Amsterdam: Amsterdam University Press, 85–107.

Oudshoorn N and Pinch T (2003) How users and non-users matter. In: Oudshoorn N and Pinch T (eds) *How Users Matter The Co-Construction of Users and Technologies.* Cambridge, MA: MIT Press, 1–25.

Oudshoorn N and Pinch T. (2007) User-technology relationships: Some recent developments. In: Hackett EJ, Amsterdamska O, Lynch M and Wajcman J (eds) *The Handbook of Science and Technology Studies*, third edition. Cambridge, MA: MIT Press, 541–566.

Pols J (2011) Wonderful webcams: About active gazes and invisible technologies. *Science, Technology, & Human Values* 36(4): 451–473.

Roberts C and Mort M (2009) Reshaping what counts as care: Older people, work and new technologies. *ALTER, European Journal of Disability* 3: 138–158.

Rogers EM (2003) *Diffusion of Innovation*, fifth edition. New York: Free Press.

Schillmeijer M and Domenech M (2010) New technologies and emerging spaces – An introduction. In: Schillmeijer M and Domenech M (eds) *New Technologies and Emerging Spaces of Care.* Aldershot and Burlington: Ashgate, 1–19.

Silverstone R, Hirsch E and Morley D (1992) Information and communication technologies and the moral economy of the household. In: Silverstone R and Hirsch E (eds) *Consuming Technologies, Media and Information in Domestic Spaces.* London: Routledge, 9–17.

Willems D (2008) Homes as in: Home care technologies. In: Mort M, Milligan C, Roberts C and Moser I (eds) *Ageing, Technology and Home care: New Actors and New Responsibilities,* Paris: Presses de l'Ecole des Mines, 62–63.

Willems D (2010) Varieties of goodness in high-tech home care. In: Mol A, Moser I and Pols J (eds) *Care in Practice: on Tinkering in Clinics, Homes and Farms.* Bielefeld: Transcript Verlag, 257–277.

Wyatt S (2003) Non-users also matter: The co-construction of users and non-users of the Internet. In: Oudshoorn N and Pinch TJ (eds) *How Users Matter: The Co-construction of Users and Technology.* Cambridge, MA, 67–81.

Wyatt S, Thomas G and Terranova T (2002) They came, they surfed, they went back to the beach: Conceptualising use and non-use of the internet. In: Woolgar S (ed.) *Virtual Society? Technology, Cyberbole, Reality*. Oxford: Oxford University Press, 23–40.

Zhao S (2005) The digital self: Through the looking glass of telecopresent others. *Symbolic Interaction* 28(3): 387–405.

Biographical note

Nelly Oudshoorn is Professor of Technology Dynamics and Healthcare at the Department of Science, Technology, and Policy Studies at the University of Twente in the Netherlands. Her research interests and publications include the co-construction of users and technologies, particularly medical technologies, and information and communication technologies. Her most recent books include *Telecare Technologies and the Transformation of Healthcare* (Palgrave Macmillan, 2011) and (with Trevor Pinch) *How Users Matter: The Co-construction of Technologies and Users* (MIT Press, 2003).