At Home with Users: A Comparative View of Living Labs

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Living Labs provide a 'human-centric' research approach for the design of new ICT artefacts. In Living Labs users participate over several design stages, providing insights into unexpected ICT use, co-creation and evaluation of new IT solutions. Although this approach is becoming more popular, there is little comparative and reflective work on its practical dynamics, problems and possibilities. In this study, we analyse two 4-year Living Lab projects in Lancaster, UK and Siegen, Germany within the domain of Social TV, and compare experiences. We focus on documenting the purposes, methods and user dynamics that affect the trajectory of such long-term research initiatives, focusing inter alia on the dynamics of researcher/user interaction and the developing issues of trust and managing expectations; emphasizing some often neglected ethical issues and the impact of users' individual characteristics and their role in the community dynamics of Living Labs.

RESEARCH HIGHLIGHTS

- Comparison and reflection of two 4-year Living Lab studies in domestic environments.
- Investigation of dynamics of researcher–user interaction.
- Emphasizing ethical issues of long-term Living Lab research projects.

1. INTRODUCTION

1.1. The 'turn to the social' and the Living Lab

The turn to the 'social' in interdisciplinary fields such as Computer Supported Cooperative Work (CSCW) and Human Computer Interaction (HCI) has been accompanied by a developing eclecticism on such matters as domain, method, analytic choice, form of 'design' and so on. This has led to extensive revision and innovation in the methods used, and arguably for good reason, in the past few years. It originates in the recognition that practical organizational and academic 'social science' interests do not always coalesce. One aspect of this is a view that academic methodological and theoretical reflections seem to have little to do with practical design problems, and a developing recognition that the term, 'design' covers many different possibilities. Not least, as HCI and CSCW's interests have turned to domains such as the home

and public spaces, with a concomitant interest in the design of 'products' rather than 'systems', so the search for new methods and best practices has continued. The approach we discuss here is the so-called 'Living Lab'.

Living Labs provide both a specific research infrastructure, either as a natural living space (e.g. families home, public spaces) or as a mock-up living space (e.g. an apartment that participants occupy for periods of time), and a research methodology for the design of new ICT artefacts. They have sprung up in a number of contexts, but originated in a concern for methods that would work in relation to product innovation, notably in the domestic arena. They were initially associated with consumer products, subsequently with 'smart home' research and then to investigate a variety of domestic and mobile products. They include, for brief mention, Orange At Home (Randall, 2003); the Philips HomeLab (de Ruyter and Aarts, 2004); Placelab (Intille *et al.*, 2005); and the Helsinki Virtual

Village (Eriksson *et al.*, 2005). They have been associated more generally with product innovation (Kusiak, 2007) as a possible solution to problems of innovation failure through processes of user involvement. As Eriksson *et al.* (2005) suggest:

> The Living Labs Concept refers to an R&D methodology where innovations, such as services, products or application enhancements, are created and validated in collaborative multi-contextual empirical real-world environments. (...) The user experience focus involves areas of user interface design and ergonomics as well as user acceptance, extending to user co-design process, finally leading to service or product creation. The human-centric approach in Living Labs conceives of human beings, citizens and the civic society as a source of innovation and not just as users or consumers in a narrow sense being an object for R&D activities.

One of the points we wish to make in the comparative study we discuss below is that hitherto the ambition to demonstrate that Living Labs are 'human-centric' has not yet been fully realized. In methodological terms, Følstad (2008) argues that Living Labs typically fulfil four functions which are described as evaluating or validating new IT solutions with users; gaining insight into unexpected ICT uses and new service opportunities; experiencing and experimenting with ICT solutions in contexts familiar to the users, and enabling medium to long-term studies with users. Again, and as we will suggest, there are a number of implications that surround the notion of the 'long-term' in Living Labs that are not always adequately discussed or investigated in comparative works.

Reasons for adoption are many but might include, depending on the particular vision of Living Lab being used, that they involve the user; get relatively quick and low-cost results; may constitute a permanent testbed; allow for 'mixed method' approaches to data collection, and of course, put the user at the centre of an iterative design process. They are in some sense participatory, 'real world', and involve the iterative testing and evaluation of products over some extended period of time. It is, in other words, an approach to evaluation and thence to iterative design with users. Having said that, and as the participatory design literature has made abundantly clear over many years, 'involving the user' can mean many different things (Vines *et al.*, 2013). Certainly, when von Hippel (1976) first argued that the 'needs' of users could and should be placed at the centre of the innovation process, he made little attempt to discuss the contingencies that might affect the process. Bergvall-Kåreborn *et al.* (2009) delineate some principles that might determine effectiveness, but provide no account of the long-term, evolving dynamics of the Living Lab.

1.2. The Living Lab and research methodologies

There are a number of methodological choices that might be made once something that looks like a Living Lab is established. As Schuurman *et al.* (2009) point out there are two different ways in which the Living Lab can be constituted. First, 'make the technology or product available in the home of the users' and secondly develop, 'a home where the technology or product is available and where users come to stay for a certain period'. They have also been used in the more specific context of interactive television specifically 'mobile TV' research:

> When a product is designed for users, data and theories regarding the users are used as a knowledge base for design. A design with users denotes an approach where user studies are included, together with feedback from the users on different solutions or concepts.

Having said this, a number of quite specific methods might be appropriate for Living Lab research. They include, for instance, diary studies (e.g. Bolger *et al.*, 2003; Carter and Mankoff, 2005; Hess and Wulf, 2009) interviewing, observation, focus groups, cultural probes (Gaver *et al.*, 1999), technology probes (Hutchinson *et al.*, 2003) and so on. Indeed, such methods have been deployed for the investigation of domestic life and the use of technology over a long period of time (e.g. Gilbreth, 1927; Hindus, 1999). Few studies, however, provide insights into the long-term involvement of users for the design of Home IT and fewer provide reflection on the practical dynamics of research and the developing relationships of researchers, users and other involved actors in this context. Sleeswijk Visser and Visser (2006) suggest that returning participants provide more profound feedback and can reflect in a more detailed manner. Even so, how to achieve these results in domestic environments is not well-specified, nor are the contingencies associated with community creation and maintenance well-examined.

We draw extensively on a version of the Living Lab perspective for our own work on Social TV but it bears repeating that the notion does not come circumscribed by methodological rules. There are many possible sources of variation, since such a lab can be located in a specific research setting where people might stay for very short or very long periods of time (e.g. Abowd *et al.*, 2000; Jago *et al.*, 2011); can be specifically targeted towards one kind of user group or to many; can entail the regular use of the same group of users, or can enlist new groups; can be constituted in geographical terms in areas with state-of-the-art facilities, and finally can be more or less 'naturalistic'. On this basis, then, we can see Living Lab research as containing elements, which might be described as 'ethnographic' as well as elements, which have to do with user participation and—more explicitly—participatory design. Having said that, in our view there are two elements, which make Living Lab research distinctive. Firstly, it aims directly to provide mechanisms for sustained participation over a long period of time, often across more than one project. In one of the cases we report on below, this participation has now extended across several years and a number of different projects. Secondly, the Living Lab offers an opportunity to introduce existing technologies—prototype or otherwise—which can be used as testbeds for further work. That is, they provide an infrastructure in which to embed technologies at various stages of development.

We would suggest that given the possibilities inherent in Living Lab work, it is surprising that there is little

comparative work demonstrating how these varying decisions might dynamically influence outcomes. The importance of this lies in what Brown *et al.* (2011) call the 'messy details' of field trial practice, focusing on some key issues that they identify as under-rehearsed. They further suggest that an 'interdependence of methods and results' has important consequences. They make a number of suggestions as to how field trial design might demonstrate some sensitivity to these issues. They suggest, for instance, treating 'investigators as participants' in various ways and, conversely, treating 'participants as investigators'. Perhaps most tellingly, they argue that:

> *To truly embrace the distinctiveness of trials we propose that this additional context is extended* (...) *and documented in greater detail. Methods sections should be more explicit about the natural contingencies and events that happen while a trial is carried out. These are not signs of a 'Bad trial', but are important details that 'let us understand better the differing contexts of particular trials.*

Vines *et al.* (2013) address these issues more from a perspective of user participation and its impact on the design process. They argue that integrating users entails some ambiguity in relation to sharing control of research processes and that the methodological foundations for such work are often under-specified. They argue that it is necessary to reflect on pragmatic and conceptual challenges, ethical issues and the preconditions of interacting groups and make procedures comprehensible for others.

Taken together, these observations constitute a critique of the casual assumption that standardized methods produce standard results. There is, in other words, purchase in rehearsing both how social arrangements influence trial results and how the same can be said of how researchers and 'subjects' interact. Here, then, we take data from two settings, both of which can be characterized as Living Labs, and seek to identify both the 'contingencies' of our approach and the degree to which the 'troubles' that Brown *et al.* identify extend to this type of work.

1.3. The Living Lab in comparative perspective

The aim of our work, then, is to present and compare experiences of two cases with a similar 'domain', in this case Social TV, using what are, on the face of it, very similar stances. The two cases are those of a research project based in Siegen, Germany and one based in Lancaster in the UK. We argue that problems and possibilities are brought into relief through this comparative lens. Based on our research, we argue here that a number of factors are important in considering the trajectories that Living Lab research might take. They include the founding purposes of the research; the users enlisted, their characteristics and their motivations; the geographical and social network entailed; collaboration policy and practice; user involvement in different design stages; data collection methods; and most importantly, communication and feedback, privacy and ethics. We draw conclusions relating to how and when design, redesign,

evaluation and collaboration between different stakeholders might be organized to produce satisfactory results.

2. THE TWO PROJECTS

The Lancaster project was and is intended to focus on interactive television, and specifically the problem of the iterative design and evaluation of an interactive television system. Interactive, or social, television is a new generation of 'digital' affordance for television and represents whole new possibilities for the viewer experience. The IPTV system provides single-click access to live TV, live radio, catch-up and on-demand content; a filter, to present the user with the ability to order and personalize the content list based on a range of contextual and social factors; an embedded video player to provide access to video content (windowed); and social widgets that are capable of providing access to a range of services (e.g. Facebook; YouTube; Twitter). The project entailed a partnership between the university, a hardware provider, a public media company and eight participating households from a local village over a period of 4 years. The Siegen project is also located in the domestic domain and aims to develop a cross-platform framework including TV, PC and smartphone to support more flexible and integrated media consumption and use of social media applications. To pursue these research goals, a Living Lab research framework was designed and involved several stakeholders from academia (two research institutes), industry (two media agencies) and 17 participating households representing future users, which were actively and continuously involved into the design process over a period of 4 years. It can be seen, then, that the two projects contain broadly similar elements in terms of partnership, method, domain and local contexts (see Figs. 1 and 2). Nevertheless, there were both similarities and differences in the way the projects were set up and evolved, as we shall see. As a first brief outline Table 1 provides an overview of the investigated parameters in this work.

3. METHOD

This study based on previous research of both Living Lab projects. Data from the UK Living Lab project comes from interviews with six families and with two 'mediators' who had been involved in previous projects. Two focus groups also took place, where members from the families were present. Interviews took place in users' homes or in a local café. All interviews were recorded, with consent. Data from the German Living Lab project comes from three diary studies with interviews after each study, observation protocols and notes from two creative workshops during the concept design, an online survey, data and observations from two user tests and one field evaluation, with protocols, audio and video recordings.Observations of two social events, home visits,

Q10

Figure 1. Installing prototypes in a participant's home in the UK.

Q11

Figure 2. Using prototypes in a family household in Germany.

casual meetings with participants in the researchers' spare time and regular exchange with users via email, instant messaging and phone supplemented these data sets. In addition, researchers from both groups interviewed each other and group discussions were held when both groups came together. The interviews focused on the different tasks of project members, the methods used in design studies and the challenges that arise from user participation within real-world contexts. Within-group

discussions experiences and findings have been brought together in order to analyse common and different phenomena. In total, four interviews, each with two research staff members from Lancaster and Siegen, and two group discussions, with representatives from both groups were conducted.

For the early analysis of the predominantly qualitative data, researchers of both projects applied an inductive coding method (Corbin and Strauss, 2008). Comparison of the challenges of setting up and running long-term Living Lab studies involved re-examination of substantive data from both projects, reported elsewhere, for instance (Hess *et al.*, 2011; Ley *et al.*, 2013; Ogonowski *et al.*, 2013; Taylor *et al.*, 2007), in order to strengthen the analysed categories.

4.   COMPARISON OF BOTH LIVING LAB PROJECTS

4.1.   Purposes and methods

While it is true that 'mission creep' is found in many research partnerships—goals may often be vaguely expressed or may become moderated over time—it is apparent that initial 'framing' will have an impact, not least because it impacts on the participation of the partners involved. Thus, one partner to the Lancaster case said, 'actually, one of the things you need to bear in mind is that we weren't that interested in users at the beginning. Our interest was primarily technical. We were concerned to produce a system that was platform independent'. The consequence was that project members were initially enlisted for their technical expertise while sociological expertise—though present throughout—was not systematically deployed. In turn, while there was a general commitment to the idea of user 'involvement' to begin with, this required no explicit methodological stance other than a reliance on an existing field site. In contrast, the Siegen team had a strong predefined user involvement philosophy from the beginning. The design and evaluation process was seen as an iteration cycle whereby prototypes were iterated step by step. At different project stages appropriate empirical methods were chosen to involve participants in the design process and encourage active co-creation based on their experiences (Wulf *et al.*, 2011). Two Living Lab environments were combined for this purposes—a local real-world testbed at the participants' homes and a stationary lab setting at the university (Hess *et al.*, 2011).

Initially, the relationship between the Lancaster University and the local village was established some 10 years ago. The origins of the relationship were serendipitous and developed from community 'push' rather than research 'pull'. As one very active member said, 'we knew there was funding available for self-help rural broadband and we wanted to build a network. We heard that a Lancaster researcher was involved in a project and invited him along to talk to us. Initially, he said he had no funding but we wouldn't let him leave and we rather bullied him, so they cobbled something together for us'. The initial collaboration, then, was informal and involved the acceptance

Table 1. Comparison table of both Living Lab projects.

|	[UK] project	[German] project
User sample	Heterogeneous sample structure, different age groups (young children to older adults, single households to families)	
Sample size	Eight households	17 households
Project duration and involvement of households	4 years	
Geographical and social distribution	Village community, participants knew each other	Regional dispersed sample, participants did not know each other
Incentives for participation	Broadband internet, test devices, lotteries (vouchers)	Provided device infrastructure (Media Centre PC, smartphone, HD TV set)
Contact person (mediator)	Two persons from the village	One academic staff member from the university
Study design	Less structured research process	Strong structured research process
Methods	Diary studies, interviews, focus groups, field tests	Diary studies, interviews, creative workshops, online survey, user tests, field tests

of responsibility on a more or less personal level. In contrast, in the German project the researchers initiated the collaboration between participants and university.

This meant that user recruitment took place in very different ways. In Lancaster, recruitment was undertaken by a 'mediator'—a woman with a long—established role in the village community who had, over time, developed both technical and management (or leadership) skills and had proved adept at enlisting members of the community for project participation. Six families were recruited in this manner. In Siegen, the approach was more systematic. First, a call for applications via local newspapers and radio was broadcast. Applicants were asked to fill out an online questionnaire with information about their demographic background, technical equipment and personal motivation for participating. Telephone interviews with the 32 applicants were conducted with a view to ascertaining additional socio-demographic facts, media usage, and technical expertise in dealing with Media Centre systems and smartphones. Attention was paid to representativeness in relation to family structure (couples with or without children and single with or without children) and technical competence (none/low and high experiences in Smartphone and/or Media Centre system usage). Initially, 8 households were selected, two from each category, with 15 participants in total (6 male, 9 female). Proximity was also a factor, and applicants were in part selected to minimize costs. A second stage of recruitment aimed at finding participants who formed part of existing social networks and so 'snowballing' techniques were used to find additional households. Eight additional households were recruited with the result that in total there were 27 participants (14 male, 13 female) divided into 5 couples with children, 5 couples without children, 2 singles with children and 4 singles without children. The end result was a sample in the urban area of Siegen, which had a degree of representativeness, but a

certain geographical dispersal and so some of the participants were not known to each other. In contrast, the Lancaster sample had no real claim to representativeness, but was drawn from a village where effectively all participants formed a close-knit community and knew each other. In both projects participants did not get any money for their efforts but were incentivized by the provision and the self-determined usage of technology (broadband, smartphones, Media Centre PCs, set-top boxes, TV sets) but also by more intrinsic reasons like curiosity, self-reflection on their own media usage behaviour, learning, participation in research, communication and new contacts. This led to different expectations on the projects and had also a significant impact on the users' motivation and engagement. While some were just happy having the technology, others were more interested in contributing to the design and development process.

In respect of method, again there were some differences. Both projects made use of diary studies, of focus groups and of interviews in order to elicit information about user behaviour and attitudes. In Lancaster (see Fig. 3), some early focus groups were organized with a view to obtaining initial 'sensitizing' results, and one organized later, shortly after the project moved to iPhones as a second screen resource. Subsequently, all data collection was done by two researchers, in the form of interviews. Lengthy interviews ($\sim$1–2 h) took place in family homes and in a local café. Interviews were recorded with permission. Q6

The Siegen approach was more structured (see Fig. 4); with active involvement of participants 'designed-in' during the entire design process. In Siegen, an initial 3-week diary study was conducted. The diary contained pages on which the participants were asked to document every single media usage with information about the usage context. Several additional pages were included with a view to understanding more
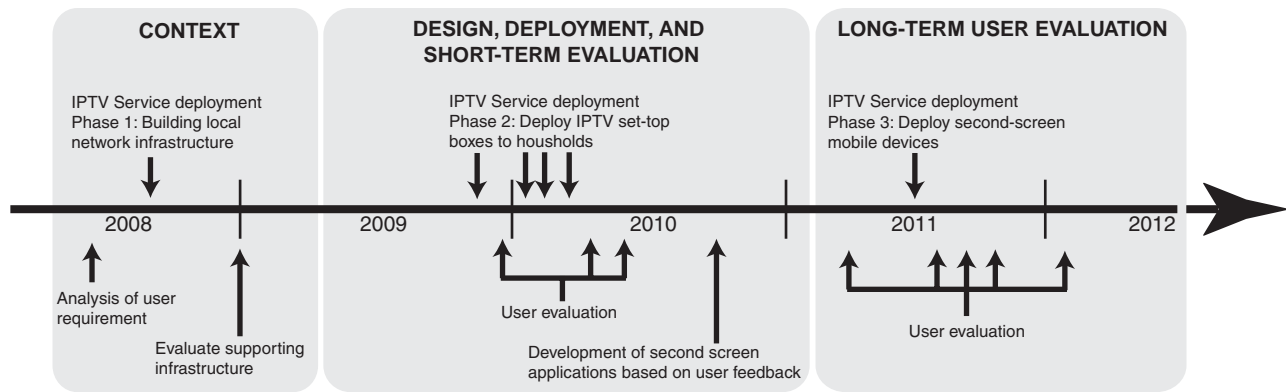
Figure 3. Progress of the Lancaster project (above the timeline: interventions within the field; below: research methods).
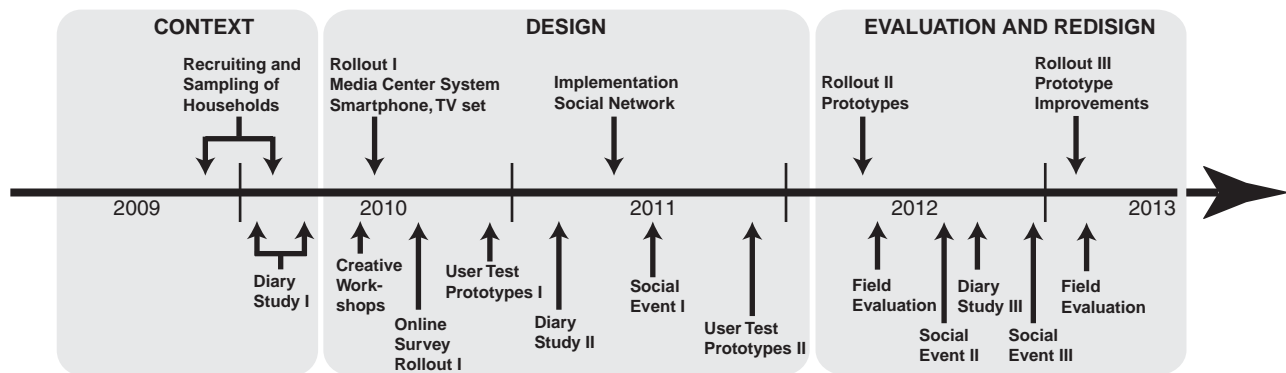
Figure 4. Progress of the Siegen project (above the timeline: interventions within the field; below: research methods).

about the participants' regional, national and international social networks, pastime activities and so on. Using a camera, participants documented aspects of their media usage to give researchers more visual insight. The diary study was also intended to help to establish a trust relationship (see below) between participants and researchers. After the 3-week self-documentation process, the materials were collected and additional interviews conducted with each participant in the household to ascertain their current media usage. During the entire project progression households were equipped with new technology twice (Rollout I and II). To understand how the new technology was appropriated and how media usage changed, the diary study was repeated after each intervention. Following Diary Study I and an initial analysis of data, for instance, creative workshops were conducted. The aim was to co-develop and discuss first concepts and ideas for an integrated and flexible usage of TV, smartphone and PC (Hess *et al.*, 2011). Following this, a low-functional early stage prototype was developed and users invited to the university's lab for evaluation. Besides a scenario-based walkthrough, participants were able to contribute suggestions in a subsequent open interview. After re-design, more laboratory-based user tests were conducted both with individuals and with groups. Following this, the prototype

was revised again and rolled out to the households (Ogonowski *et al.*, 2013).

This relatively high degree of structure, then, had certain advantages in relation to links with users and the regularity of feedback. It also, however, came with a certain cost—'user fatigue'. This was evident, above all, in the diary studies. While the motivation for completing diaries was relatively high in the first Siegen study, this assiduousness subsided precipitately with subsequent studies, and most participants were visibly vexed when asked to complete diaries again. During one home visit, for instance, one participant rolled her eyes and welcomed the Siegen team with the words 'Oh no, not again!' on seeing the documentation box they wanted to hand over. Again, this raises an important question concerning self-reporting of behaviour. The point here is that there was a divergence between the self-report conclusions and other, more objective data. There were also differences to be found in the views of different members of the household. Thus, when Siegen researchers asked a participant about any changes regarding the new devices they had introduced, she answered: 'I always do the same. Until now the Media Centre system doesn't offer much new'. Her 17-year-old daughter, nevertheless, claimed that her mother's usage behaviour had changed insofar that she now used the

Media Centre system much more. The Lancaster experience was similar, but even less successful. Unless continually prompted, participants proved unwilling to continue with diary work for more than a limited amount of time. Our view is that, in this context at least, diary studies had limited value. Quite how reliable they were over an extended period of time remains unclear. Diary studies are not unreliable per se, but clearly need to be triangulated with other data.

4.2. Participating users

Participatory design philosophies and practices have entailed various methods and tools that focus on the involvement of users in (re-)design processes (e.g. Bødker *et al.*, 2004; Greenbaum and Kyng, 1991; Kensing and Blomberg, 1998). The focus has often been on the mutual nature of the learning process with attention to the long-term and continuous nature of user involvement for shared understanding. This, however, is not necessarily easy to achieve. Certainly, in respect of long-term involvement, changing expectations need to be considered.

4.2.1. Geographical and social distribution of households

In relation to the different user groups and environments, the diverging nature of the two groups had certain consequences. In the village of the Lancaster project, all participants were known to each other and often lived close to each other. This density of local and regular face-to-face interactions was not duplicated in the geographically more dispersed German sample. For them the Living Lab was initially a relatively formal and impersonal institution. This became obvious during the first workshops where many participants were aloof and nervous. Moreover, the structured workshop program did not allow participants to contact on a more personal level:

> (. . .) *during the workshops everybody was focused on the project discussion so that personal conversations did not arise out of the situation. The same applied to the user tests. Conversations with others were almost impossible, because the tests were executed one after another.* (*male participant, Siegen*)

This means that a more dispersed group of participants required a greater effort from Living Lab coordinators to provide a social space for participants to get to know each other. Later on, several social events (e.g. barbecue, visits to a Christmas market and beer garden) were organized for this reason.

The way in which user populations were selected and structured in the two cases had one further, and quite important consequence. This had to do with our ability to evaluate social media use. Results with different user populations relying on different methods suggest a willingness to use social media when watching television. Barkhuus (2009), for instance, reporting on the 'social' or 'interactive' experience in a small study of young college students found they were very likely to communicate synchronously. For reasons to do with the friendship patterns or geographical dispersal in our groups, we did not find this. As a participant in the Lancaster sample said when asked about 'chat' functions:

> *Not really . . . I chatted with Carol about it . . . but not on the system* [*laughter*] *. . . I can't see why you would . . . I talk about it with people on the street when I meet them . . .*

Even though the user sample in Germany was more dispersed, we obtained similar results. In this context, the Siegen Living Lab had to deal with two barriers. First, existing friendship networks in the sample were very limited as mentioned above. Secondly, sending friend requests has a moral implicature, and people were reluctant to do this:

> *I should have applied directly together with friends rather than on my own. It would make things easier. I noticed that some participants did this and I don't wanna get on the others bandwagon. I also couldn't join the BBQ which didn't make it better.* (*mother, Germany*)

And another said:

> *That's my personal view of social networks – I would like to know the people with whom I am connected. On this basis, I'm able to make use of friendships. However, most of the time when I was online, no one else was there. I would like using this chat functionality* (*Germany*).

That is, sample size, location and method of selection all played a part in a failure to achieve any critical mass in relation to social media use. Arguably, this was the most significant failure in both projects.

4.2.2. Heterogeneous roles

Research has shown that particular users can be much more influential than others in participative research (Brown *et al.*, 2011). For the most part, however, consideration of this has been limited to understanding the role of 'lead' users. Our experiences suggest that users, and hence their commitments concerning the reasons why they participate in research projects, vary a great deal. As a function of both the deliberate policy of selecting a structured sample, and of a more systematic commitment to communication with users as well, it was possible to identify variations in expectations and motivations over time in Siegen. Some participants, for instance, expressed an enthusiasm for the research process itself. As one technically experienced male participant put it:

> *I can express my visions and discuss novel concepts together with others, in the hope that some of my ideas will be implemented. If not, it does not matter. Anyway, if the system is available on the market, I can tell my friends that I contributed to it.*

Others, in contrast, felt their role to be very limited and specific. As an example, one 47-year-old female, less experienced participant, who worked as an architect, wanted to apply herself as an expert in visual design but was not interested in using the applications later on:

I cannot contribute in the community/Facebook/new stuff – my friends have no taste for it and me neither. (. . .) I guess I am a prime example of a dinosaur in your young social community (. . .). For the development I could possibly help a bit with my viewing patterns (. . .). (female participant, Germany)

One of the major differences in the two projects, we discovered, was the role of mediators. In the village near Lancaster, the researchers relied heavily on a small number of people— over time this became a single person—to enlist participants for this project. Their relationship with certain members of that community goes back a long way. As a Living Lab, the population of this small village has been extensively studied (see e.g. Taylor *et al.*, 2007) as various technologies, such as public displays, have been trialled there and this fact, along with the different kind of social arrangements to be found in a small village, may explain some differences in the results which were obtained.

There are advantages to this, notably that this long-term relationship means a partnership with someone who—over time—developed an understanding of research and its issues, a level of technical competence and who can, in principle, communicate this to other participants. This person not only acted as a proxy for the Lancaster University in explaining the purposes of their research activities, but also acted as an intermediary in a more practical way, informing the research team when faults occurred, explaining to participants how certain functions worked—even providing support for the network. Now, 'Carol' as we shall call her, did not watch very much television. Indeed, she suggested that the only time she makes an effort to watch television is when her daughter recommends specific programmes, or when her grandchildren are in the house. On the face of it, this is quite different from the kind of 'lead user' reported by Brown *et al.* (2011). Here we have someone who makes little or no use of the research technology in question but nevertheless makes huge efforts on behalf of the research team:

Carol: It's got to fit into your life (. . .) it's got to be of some use (. . .) but for me, it's a way of paying the university back for the broadband (. . .); they still fall by the wayside cos it depends on how busy you are, what you're interested in, how much trouble it is (. . .) but it's my role to encourage them. What I would do, if we could get the chat working better, would be to use it to help (. . .) give people instructions.

Researcher: Working with the community, do you get frustrated?

Carol: No, I love it (. . .) it's so rewarding, I can do it all day (. . .) showing people how to do things. They'll come to you if they want something. To be entirely honest- I know you work for them- if anything is frustrating, it's the university (. . .) [goes on to detail various problems she has to contend with when working with researchers].

Certainly, this made recruitment easy. At the same time, this relationship was not always straightforward. Lancaster's mediator was, and remains, highly committed, but there is little doubt that this role has proved very demanding. We should note that, because the village has been used several times as a testbed for various prototypes, researchers had originally relied on two people who voluntarily performed this mediating role. One, who had completely dropped out after a period of time, was very candid about her reasons:

it just got too much (. . .) to be honest, I found the demands unreasonable and I didn't find the university very helpful (. . .) I didn't think it lived up to its responsibilities (. . .) and I'm not like Carol, I'm not so motivated (. . .) let's face it, she's the reason things get done here.

It arguably has a further consequence, which is that of distancing researchers from participants in the early stages. It meant that sometimes the mediator took it upon herself to solve simple technical problems and was the first port of call when more difficult matters needed resolving. As implied above, the user population here had a fairly homogeneous view, which was that they were happy to participate as long as they perceived some benefit. It was the mediator who saw her role as entailing a commitment to research. One lesson became very clear to the Lancaster researchers, which was that the involvement of social scientists was less systematic in that they never took the specific role of 'point of contact'. Indeed, no one really did. There is some evidence that the role of social scientists was at least as important when it came to evaluating the project as it was in relation to collecting data about use. Certainly, interview sessions often prompted reflection on the project, its purposes and its successes and failures. This was different in the German project where there was no such mediator within the group of participating users because of the previously mentioned geographically dispersed lab structure. Here it was necessary to allocate a person from the university staff as a 'point of contact' right from the beginning. This person, however, did not have a strong personal relationship to users and it took an effort to establish trust relationships. However, this academic staff member acts as a 'boundary agent' in different ways. In a way, she mediated between participating households, industry and researchers itself. For the users, the staff member served as a help desk that supports the appropriation of new technologies. For the industry as well as for academic partners, she served as a translator of the users' needs and facilitated mutual learning between users, designers and researchers. In contrast, Carol in the UK project functioned more specifically as a community representative and organizer. Both roles implicate ethical issues, which are further discussed below.

4.3. Trust and expectation

4.3.1. Trust and the research relationship

Here, our main interest lies in relations between participants and academics. There are significant differences between both groups of actors, differences that are not always made explicit. These differences mainly have to do with the expectations that

tie into the ordinary, day-to-day rhythms of family life. They can be summarized in the following ways.

First, users often have work with background assumption that 'repairs' can be enlisted from outside and, if so, repair work will be timely. The participants in Lancaster, for instance, sometimes complained that it might take several days before someone from the university came to deal with system problems. It was not unusual, in the UK case, for the 'mediator' to take work of this kind on herself so as to forestall complaints. The point here is that user expectations were and are formed out of their everyday experience of breakdown and repair and not by what the working priorities of academics might be. Participants expected quality service and became frustrated when they did not receive it. They were rather intolerant of the ability of academic partners to deal with breakdowns in a timely way. Inevitably, given the prototype status of the technology, these breakdowns were more common than one would expect from commercial equivalents. More importantly, this is a technology that forms a fundamental part of most peoples' lives. Of course, academics have other priorities and certainly do not see themselves as repairmen. In Siegn, this even extended to asking for assistance which had nothing to do with the system itself. Researchers in this latter case, for instance, were enlisted to repair a broken satellite cable or in another case to set up a Wi-Fi connection for the daughter's laptop. As one researcher said, 'some of the participants saw us as a 24/7 help-desk'. Our point here is not that users are 'right' or 'wrong' to make such demands, or that academics are 'right' or 'wrong' to prioritize their efforts in different ways, but simply to point out that these expectations are embedded in quite different routines. Diverging presuppositions arguably need to be managed very carefully.

Similarly, routine expectations are grounded in existing experience of technology. One reason for the relatively high level of acceptance in the UK village, at least to begin with, was that experience with TV and Internet resources had previously been poor. The village is in a very rural area where broadband facilities and TV reception had historically been very poor. This slowly changed as commercial networks become more available (and reliable). The initial rollout in Siegen had been based on Windows Media Centre, which had been both robust and reliable. It fitted the routine demands of family life. *Rollout 2*, which users had waited some time for, while technically more innovative, was less robust and engendered frustration. Hence:

> *The biggest problem for me is, that most of the functionalities can be used in a limited way or didn't work. That leads to disuse and you want to go back to the Windows solution. That's why I couldn't give you more than a little feedback.* (male participant, Germany)

Some participants felt guilty if they did not or could not fulfil the given tasks. Even when frustrated and negative, they felt obliged to provide feedback:

> *I feel so bad that I did not use the feedback app and that we do not do enough for the project although we have gotten the devices from you. But I always tell my kids that they have to use the TV application!*(*Mother, Germany*)

There is, put simply, a moral implicature in respect of participation. Participants react in various ways, but all recognize a degree of accountability. Users often felt obliged to participate in workshops, interviews, diary studies and testing in return for the received technology. Some occasionally spoke negatively about the less-than-wholehearted participation of others:

> *Where are the other households? It cannot be the case that we attend with three persons and others are always absent. They also have got the devices.* (*Mother, Germany*)

Where participants dropped out, justification often had to do with perceived failures on the part of university staff, either because they (in the eyes of participants) did not understand local concerns or because they failed to provide and maintain adequate hardware/software. That is, accountability was seen as reciprocal. This 'moral universe', we discovered, is quite separate from formal ethical considerations. Most participants confessed they did not read the ethical guidelines given to them in written form or available online. As one said:

> *We're not that interested. If we didn't want you doing this work we wouldn't have anything to do with you. We get something from it and, as long as we do we're happy with you.*

As another said:

> *My relationship with the university is brilliant, excellent. I don't really care what you're up to as long as I can see the benefit.*

4.3.2. Trust and the user

Here, again, there is an important point to be made. When recruiting users, there is a tendency to think of them as 'units'. That is, they are recruited as individuals, or 'households' or as 'communities'. Treating them this way ignores the dynamic inside the unit—the normativities and 'rhythms' we are interested in. In both our samples, it was often the case that there was a prime mover for participating in the project. This person was often male, had a strong interest in the project, was motivated to participate and act as contact person. This is evidenced in the UK sample in the following exchange:

> *Researcher: How about the fact that people tend to be fairly private about their phones (. . .) if you're using it as a remote it can't be that private, can it? If there's more than one person wants to use it, I'm just wondering if there are any issues about who's using it or where it is, or who gets to choose, or can I borrow it?*
>
> *Father: I haven't, because I'm the only one using it* (. . .)

Again, other household members—in particular wives and children—can sometimes show less interest in research aspects. This was the case, for instance, in three of the participating households in Siegen. Involvement in the project did not necessarily mean enthusiasm on everyone's part. When new input devices and software interrupted familiar usage behaviour and sometimes meant that users could not switch on the TV, then

unwilling participants could get very frustrated. This even led to the point that other household members could not or limited satisfy personal needs. One family father described the situation as follows:

> Based on the fact that I work in shifts I often come home very late and I have to put up with [moaning] (…) it makes no sense testing your system any longer. It would mean to me that I have to replug all cables every night, so that my wife and my daughter can watch TV in a normal way next day. I don't want this!

As we have seen, family dynamics vary considerably. This underlines the challenge when dealing with new entertainment concepts on shared family devices like the TV set in the living room. Multi-person households, especially with children of different ages, need to be seen in terms of the ongoing management of family relations.

We will suggest here that we can think of these differences in expectation as having to do with trust. There is a considerable literature on 'trust' which we have no space here to discuss, relating to matters such as its cognitive and social aspects (see Möllering, 2006 for an overview). Perhaps surprisingly, there is relatively little on trust as a practical matter. That is, what factors lead in practice to the presence or absence of a trusting relationship over time, especially in the context we are describing. Trust in this instance has two important, and distinct, elements. These are trust in the research relationship and trust in the research technology.

4.3.3. Trust and expectations of the research technology
We found some differences concerning developing technologies and applications. In the UK village, although the technology in question was not especially robust—especially in its earliest incarnations—there was a significant degree of fault tolerance. Thus and for instance:

> I really like it (…) I've been missing it on holiday (…) I've found, with perseverance, that it's much better now than it was when we first got it. (…) yeah, there are lots of things that are not altogether perfect like I can't see the writing (…) I've tried to wear glasses and I've found it quite difficult (…) we've got a little telly and it really does make it a problem (…)

Similarly:

> I found that, a programme you begin to watch one day (…) you can't find the next (…) that happened yesterday (…) but on the whole I use it much more than I used to use the iplayer (…) It's just easy to use (…) from my point of view, I just go on to the searches, browse it, and find things I haven't seen (…) I know it's on the box and I can watch when I like, and it's good.

In comparison with that, in the German project we found a lower degree of fault tolerance. One reason was the long waiting period before first prototypes were rolled out. During this period marketable solution were integrated into participants everyday life and influenced further expectations. Even though the Siegen researchers stressed the given prototypes are not so stabile in usage, participating households expected a proper solutions and lost trust in our technology in a way not using the prototype to record or watch interesting TV programs.

Our researches further indicate that trust in the research process in the context of Living Labs is largely predicated on the intensity, frequency and 'personalized' nature of the interactions that take place. As stated above, trust is to some extent a function of timeliness—the ability of academics to intervene in ways and at times that meet users' ordinary, everyday, perceptions of 'how things should be done'. Further to this, however, when such repair work was undertaken, participants in the Lancaster sample sometimes reported that they did not feel engaged in the process when, 'some young man turns up, hardly says a word, fixes the thing and then disappears never to be seen again (…)'. Some aspect of this is evidently to do with personal contact. As participants said in an informal group discussion (in a café) during the latter stages of the UK study:

> we enjoy talking to you guys. It's always nice when you come here and show an interest in what we're doing, buy us coffee and cakes. We get to know you that way (…).

This is brought into sharper relief in the German case, where the project was structured so that there was always a single point of contact. In addition, it was a matter of policy to punctuate the more formal research stages with informal get-togethers, which were primarily social in their function. The intention here was to allow users to get to know each other (with the idea of strengthening network possibilities—something that was hardly necessary in the village scenario) but there is little doubt that they served equally well for participants to get to know researchers. Here, we identified the same problem as in Lancaster. Participants often wondered who it was doing the technical configuration during home visits. Project staff members changed during this time and this changing circumstance was noticed and remarked on by users. That is, in both projects, the importance of continuity was evident. Trustful relationships were, in this instance, built over a relatively long period of time.

Taken together, the cases indicate to us very strongly that communication, in and of itself, was not enough. Participants needed a regular point of contact, to feel that their requests and complaints were being dealt with, and to feel that these communications were in some sense 'personal'. That is, even though participants were aware that 'research' was the objective, they nevertheless wanted to feel they were more than simply the objects of research.

4.4. Implications of time

In consequence, one obvious feature of a long-term relationship of this kind is that, and unlike other projects, it is not possible or desirable to 'parachute in' researchers. Obligations of a subtle nature are often evident. These include a willingness to be available at times relevant to the needs of participants, a need

for technical expertise and support beyond the life of individual projects, and a nuanced view of entitlements in respect of 'kit'. It also involves recognition of the efforts made by participants. In the UK project it was interesting to see the different perceptions of two leading figures in the village, both of whom have been heavily involved in research projects with the university and with other initiatives. While one, for reasons she identified as being to do with her own character, continued to view work with the university very positively, for the other frustrations over the amount of work she had had to do, and the communication difficulties she perceived meant that she had more or less ceased to collaborate. Both intimated, to differing degrees, that there were times when they felt 'taken for granted'.

The early involvement of participants in the design process and idea generation in the German project aroused definite expectations on the prototype development. Participants were curious about the results and became impatient concerning completion and rollout of the software. During the time it took to develop the prototype, the users' motivation and interest in the project strikingly decreased, as they could not track the development and its progress.

Besides that, in consequence of the long-term collaboration, the German project had to deal with several social and market dynamics, which influenced the project process. Varying and changing interests over time alongside changes in participants' daily routines (e.g. job change or moving house) resulted in poorer availability and dropouts from the project. In Siegen, for example, academics were facing changes in the household structures insofar as a single household became a couple household and finally a family household. In another case a couple brokeup and we had to source additional hardware to equip an additional household. Another couple moved to a new location, which was further away from the university and did not provide a satellite TV connection, so the project team had to switch the tuner hardware for cable reception. Next to these social dynamics one major challenge was the continuous advancement of the markets in the area of home entertainment and smartphones. For one thing, in both projects the hardware provided (e.g. smartphones) became out-dated over time and participants either started to buy newer devices by their own as it was the case in Siegen or had a newer kit provided in Lancaster. This led to a heterogeneous device environment at the users' homes and software prototypes became less robust. For another thing Smart TVs with manifold features entered the market and became increasingly popular and affordable. As a result some participants in both projects stopped using the hardware and software provided, preferring more robust commercial solutions.

The aim of both Living Lab projects was to embed rolled out devices into participants' everyday life to obtain realistic use settings. Although the conditions under which research will be undertaken are made clear and available to participants, it is not easy to remove equipment from them at the end of the project cycle, especially if one has to rely on the same constituency again in the near future (see also Taylor *et al.*, 2013). This has led to a degree of negotiation concerning rights over equipment. As one interviewee in the UK project said to us in response to a question about this, 'I told [him], you'll have to shoot me if you want to take that away. I rely on it and my kids need it. You can't have it'.Similar experiences were found in the German project where some participants asked to buy the devices from the university, even those participants who left the project prematurely.

5. CONCLUSION: LESSONS LEARNED

In 'Deploying Research Technology in the Home' Tolmie and Crabtree (2008) examine the ways in which research deployments interact with and occasionally disrupt the routine organization of the home and how this in turn, because of its impact on the domestication or the 'taming' of the technology, has implications for any analysis of the processes of domestication and design. They suggest, quite rightly, that research participants invariably have a set of existing relationships with technology that are, to some extent, 'breached' during the research process. In particular, existing ideas about the positioning of technologies within the home and ideas about ownership and responsibility for maintenance and repair affect attitudes towards the technology and hence any analyses we might wish to construct, thereby creating the interesting dilemma: 'how are we to understand the deployment of technology in the home to be research into how technology is oriented to and treated as an integral part of the home, when research is focused on eliciting the remarkable rather than the mundane qualities of the technology and its use?' We believe the Living Lab as we have practised it goes some way in resolving this dilemma: first, through the long-term nature of the deployment whereby the technology was given the time to be 'made at home' with the rest of the domestic space and thereby overcome some 'anthropological strangeness'; secondly, because the technology was introduced, the set-top box for example was regarded as largely complementary to an existing TV technology that remained in place at the end of the research; and thirdly, because of the careful consideration of aspects of the ethical relationship between researchers, participants and the technology. The approach of the Living Lab as adopted and documented in these two deployments is a method whereby, as Tolmie and Crabtree suggest, design teams can 'develop and exploit a sensitivity to the real world, real time character of technology installation in the home and to user expectations'. While obviously aware of some of the problems of the research relationship, we suggest our current Living Lab studies contribute significantly to avoiding or overcoming what Stewart and Williams (2005) call 'the design fallacy' whereby particular and unchanging values are attributed to users, users' responses to technology are ignored and, in consequence, the system or application becomes increasingly divorced from and irrelevant to users' circumstances and needs.

We observed some differences in the ramifications of the two studies, largely based on the different degree of systematicity and which came with both costs and benefits. The German study was more highly structured and had more carefully organized research 'intervals' with which to collect feedback data. This arguably produced more nuanced conclusions in respect of user heterogeneity and its relationship to feedback about design issues. At the same time, 'user fatigue' seemed to be more pronounced. Certainly, diary studies had a pronounced diminishing return. This systematicity also varied with regard to relations between academic and commercial interests, and created problems of their own. There were evident differences in terms of judgements about the roles each partner should adopt, what they might expect from each other and specifically about the value of methods used. It is unclear whether a more explicit definition of role, method, etc. at the outset would have made any difference. As best we can tell, from both studies, some of the tension resulted from the very rapid way in which commercial interests have to respond to external factors, notably the market.

Much more importantly, however, we spoke above of the unrealized ambition to render Living Labs 'human-centric'. Our purpose was and is not to argue this has not been done, but that it has not been shown to be done, particularly when 'human-centric' includes some notion and some understanding of the long-term ethical issues that face research. It is a large part of our argument that Living Lab research depends on a sophisticated grasp of the moral universe that researchers and their participants inhabit. There is, to our knowledge, very little discussion of the ethical issues surrounding long-term collaboration with users (however, see Taylor and Cheverst, 2012; Taylor *et al.*, 2013; Vines *et al.*, 2013). Again, the intention here is not to sermonize about the need for an ethical stance, but to show that ethics have a very practical dimension. The obligations that researchers have towards their partners in research should not be considered in the abstract but as a recognition of the very practical ways in which partners can feel 'let down', ignored, undervalued and so on. Formal ethical guidelines, 'informed consent' etc. while necessary, do not adequately encompass the 'real' issues. Indeed, we might go so far as to say that issues of 'informed consent' etc. were of little interest to the participants, even when explicitly pressed on the matter. Moreover, the precise character of these ethical issues is determined in part by the long-term nature of the projects in question.

If Living Labs are to be a successful long-term instrument, then we would suggest we very much need to understand what the 'human' processes entailed might be. Perhaps the most significant result from the researchers' point of view, because it infuses everything we have rehearsed above, is the importance of what we can call, 'practical ethics'. It is no great discovery that relations between human beings are normatively founded—it is, after all, a founding principle of Sociology and, methodologically speaking, fundamental to participatory design processes (see Greenbaum and Kyng, 1991) for a classic rendition of this theme. Nevertheless, in the context of a research methodology that is intended to implicate a long-term relationship, we have seen few reflections on how this works out in practice. The main purpose of this paper is an attempt to rectify this and draw some conclusions from our comparison.

5.1. Researcher–user relationships

We have argued that there are various ways in which trust relations are successfully established and maintained. Not least, we see how the specificities of a relationship with a local mediator in the Lancaster case as against a more directed approach to the 'point of contact' shift the interactional balance. The mediator has proved enormously useful as a point of contact and as acted as a normative force in the sustainability of research efforts. At the same time, it is easy to allow a transfer of responsibility in such a case and the result, arguably was a lower degree of tolerance over academic involvement. It is important that the role of mediation cannot be over-stressed. The success of the long-term collaboration in the UK village depended almost entirely on the ability of one, possibly two, people to recruit, persuade and engage. As ought to be clear, the level of commitment and expertise demonstrated by such volunteers is remarkable, and collaborations of this kind could not succeed without their work. It is notable that successive projects have 'piggybacked' on this goodwill, but efforts to maintain good relations and show the requisite appreciation have not been consistent (this might be because different research groups are involved). We argue that 'mediators' here do not perform the same role as 'lead users' as they are sometimes described. This has both positive and negative features. A mediator can accept a very significant role in the process, often taking on functions beyond those that were originally envisaged. In the Lancaster case, this had positive consequences in terms of ease of recruitment, and as an immediate resource for answers to questions and dealing with simple technical difficulties. The cost, however, was a more distant relationship between researcher and user. Our own feeling, based on our interviews, was that users do not always feel 'championed'. They comment, as we have pointed out, on the somewhat reticent behaviour of (for them) anonymous people who 'come out, fix the equipment, say nothing and then disappear [. . .]' They express some frustration at the inability of researchers to understand the demands of family life and its routines, and their inability to identify exactly who they need to be talking to. Clear allocation of responsibility for communication with participants at timely moments helps a great deal. In the Siegen case, there was always a nominated point of contact. For that person, an academic rather than a community member, that entailed other kinds of difficulty. As she said,

> (. . .) *sometimes, I'm dealing with people that I know very well. They are my friends. I have to make decisions about what 'data' is, what I can say about their attitudes when, for them, it is not always clear when we are in an interview situation and when we are just talking.*

The downside here lay in the fact that users had overly high expectations of academics as a result of that more personal approach and were arguably more easily disappointed as a result.

In conclusion, what is clear is that issues of responsibility, including those of how we identify what our responsibilities might be; who holds them; what they entail; and how we discharge them, are matters of the negotiated order. It has long been the case that engaged researchers have argued for the treatment of participants in a more reflexive way and we fully subscribe to such commitments. Nevertheless, in a context where research relationships are predicated on lasting commitment, they cannot, they will not, be determined by us alone. They evolve over time and in delicate relation to the needs and desires of our partners.

5.2. Project dynamics and expectations

The moral universe encompasses user expectations and the ways they change over time. We noted that the mediator in the UK project developed a considerable degree of technical expertise over the years and often involved herself in significant repair and development work. She was also an expert in, and very reflective about, interaction in the community. As she once said, 'there are people in this village who cross the street when they see me coming (...) they're afraid I'm going to ask them to get involved'. The support that is provided in projects of this kind is all too often only technical. This is largely, we think, predicated on the assumption that the 'user', as argued above, is an individual unit and, as a result, little thought has gone into the dimensions of family, community and participant–researcher interactions in relation to their long-term moral implications. For some users, participation brings its own reward. More than one person reflected on the pleasures of participation, but equally that this was enhanced when 'the university takes some interest in us'. Having said that, some frustration was expressed over the time it took to fix problems; the disappearance of technology at the end of projects; and over 'being taken for granted'. One respondent, involved during the whole project cycle we report on, commented as an aside, 'I've never received a single penny for what I've done'. One further observation has to do with community-identified needs. Although there are evident limits on what researchers can do outside of the formal remit of the research, it is noticeable that appreciation of efforts made 'above and beyond' was significant. Hence, '[X] helped us a lot with the setting up of the mesh network, even though there was no funding at that time. He's a very nice man'.

Overall, 'taking users seriously' is a function of not only regularity and intensity of interaction, but also of a conceptual shift. Living Lab research depends, we suggest, on a vision of the user as engaged in a web of interactions in the family, in the community and with researchers. This is particularly significant when we consider 'time' as a factor. Even though we are describing long-term collaboration, time is a relevant factor in the short term as well. The lives of most people are governed by a series of interactional routines, and the lives of the participants in the project are no different. What is evident is that the routines of university researchers and those of participants are not necessarily contiguous. On the one hand, users clearly appreciate care and commitment when they experience it, but on the other that level of intervention, if not accompanied by equally effective innovation and prototype management, can lead to disappointment. An alternative consideration could be the deployment of a dedicated 'user engagement' member of the research team that fulfils a similar role as the mediator. This may provide deeper insights into the research field and a stronger relationship to all involved participants. However, this is significantly more expensive and requires embedding with the local circumstances.

The same normative features are visible in the fact that users in both instances have to manage relations with each other—visible in the management of family life and of networks of friendship. It became apparent, with the benefit of hindsight, that both projects were relatively poorly set up in the first instance for the investigation of social media use. The reasons, however, were different. The fact is that village life involves a dense network of face-to-face relationships and as such there was little perceived need for any synchronous use of the social media with television watching. In the German case, again it probably had more to do with the very systematic approach adopted. An attempt to 'design in' social media functions was at best only partially successful. The reasons had to do with the fact that existing biographies have a powerful impact on the kind of interactions people are willing to take part in. In the absence of existing friendship patterns and a high density of use, critical mass was never reached. In much the same way, making sense of patterns of use necessitates attention to the ordinary day-to-day, sometimes moment-by-moment character of family routines. The general point here is that arguments about 'types' of user, and understandings of the use of the Living Lab approach, should incorporate not only individual characteristics and motivations but also the way they intersect with other, family and community dynamics. These, to reiterate, are not primarily problems of method, at least narrowly considered, but problems which have to do with our understanding of the moral universe we inhabit and how it is shaped over time by changing practices, expectations and reciprocal awareness.

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