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Place and Technology in the Home

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Abstract. The home is a complex environment, designed for general use but shaped by individual needs and desires. It is a place often shared by several people with different demands and requirements. It is a place embedded with technologies utilised at various times by people in diverse ways. Until recently most home technologies have been primarily functional; aimed at easing domestic chores such as cooking, washing and cleaning. In the last few years information and communication technologies have added to the technological complexity of the home. Entertainment technologies have become increasingly dominant, as the simple TV has given way to video, DVD and satellite or cable services. Technologies converge and diverge to create new hybrid experiences; a trend which we see continuing. Moreover in the future ubiquitous and ambient computing devices and functions will become hidden and communications between devices will become more complex. It is against this background that we undertook a number of studies into the place of technologies and technology use in the home. We studied the placement and use of existing technologies in five homes in Scotland using a novel, multi-part, naturalistic methodology. Transcripts from the studies were analysed using a grounded theory approach in an attempt to draw out key, recurring concepts concerning technology use at home. Eight concepts – place, learning, utility, interaction, control, cost, lifecycle and privacy – emerged from this analysis. Additionally, four types of space were identified in homes; communication, work, leisure (private) and leisure (public). In this paper we focus on these four spaces and how they fit in with previous work on places and spaces in the home. We present a contextually grounded method of investigation of home technologies, the technology tour, and show how the four spaces in the home can be understood and represented as maps of the home layout that are often different for different members of the household. This understanding of place can be set alongside an understanding of technology where the themes of utility, interaction, cost and lifecycle are most important. General design issues that cross place and technology in the home are discussed in the final section of the paper. These can be used to sensitise designers of both artefacts and physical spaces to the needs of people and their use of technologies at home.

Key words: technology tour, spaces, places, children, home, user centred design, maps

1. Introduction

Homes are places loaded with emotions, meanings and memories. The home occupies a physical space designed by architects who were constrained by the materials, markets and costs of their era and by the politics of their employers. The home is full of technologies that were designed and produced by people who

had never seen where their designs would finish up. Homes are lived in by people, in various groupings, who undertake activities and interact with each other in this technological and physical environment. The development of ambient technologies will increasingly make the fabric of the home react automatically and behave autonomously.

The background for the work reported in this paper is that we were investigating a new technology for the home; specifically a 'home information centre'. The assumptions that the developers were making about where such a device might reside, what it might do and how it would be used, prompted us to undertake an investigation into technologies and the home. We were interested in two issues. Firstly, how should designers undertake the design of technologies for the home; what methodology, methods and techniques are most appropriate for their purpose. Secondly, what features of technologies and technology use were important to people; what concerns did they have about technology use at home. We wanted to focus on how to undertake the design process from a human-centred perspective and on the generic qualities that usable and engaging home technologies should have.

Of course the home, and the role of technologies in the home, has been the subject of much research, particularly in recent years. The proceedings of the IFIP working group WG9.3 on Home Oriented Information technologies (HOIT) is one source (HOIT 2005), work of the UK's Equator project is another (Equator 2006) and a third is the US National Outlook for Automation in the Home (NOAH 2005). There have been special issues of the journals *Cognition, Technology and Work*, (CTW 2003), *Personal Technologies* (2000) and the *International Journal of Human–Computer Systems* (IJHCS 2001) as well as many papers in conferences such as CHI. There have also been many studies of homes and technologies from sociological, anthropological and socio-cultural perspectives.

Our perspective is oriented towards the designers of systems, services and products for use in the home. As designers we create tasks, activities and experiences for people. The reason that you have a task in your life such as pressing some long and complicated combination of buttons to find the TV channel you want is because some designer has created it. Designers make work for people. Good design is a joy. Poor design makes lives miserable. It is the unnecessarily bad features of the design of home technologies that we seek to banish by providing methods and tools for designers. Our aim is to find ways to sensitise designers to the use and features of technologies that people think are important and the breakdowns that can occur with technology in place.

One source of inspiration for this analysis is the work of Charles Rennie Macintosh. MacIntosh was an innovative architect and designer of the early twentieth century. He created some inspiring buildings such as The Glasgow School of Art. He also created some of the most aesthetic and enduring domestic artefacts, decorations and interior spaces. He felt that architects must analyse the

disparate activities that take place within a room and then provide the means to accommodate them through artefacts (MacLeod 1983).

Another influence has been the development of 'technology as experience' (McCarthy and Wright 2004). McCarthy and Wright present a view of pragmatic aesthetics that aims to move human–computer interaction (HCI) away from its grounding in utility, usability and work towards the 'felt experience' of people. Their work seeks to provide a foundation for an aesthetic approach to seeing technology as experience. Technology as experience aims to provide an 'aesthetic–experiential lens' through which to view people, activities, contexts and technologies and hence to heighten sensibilities to how people really feel using technologies. The home is a place where we think that the felt experience and the aesthetics of technology are particularly important. As the home becomes increasingly technologically enhanced people's sense of place and experience requires a more nuanced understanding.

In this paper we explore both the methods and issues of place and technologies in the home. Section 2 provides a background to the home, the activities that people are engaged in and the place of technologies in that context. Section 3 discusses how designers of home-oriented technologies and increasingly designers of the built environment can better understand the nature of home and technology use. In Section 4 we present the technology tour, a contextually grounded method of understanding places and technologies in the home and briefly discuss the results of an analysis of five households in Scotland. In Section 5 we concentrate on places and spaces in the home, using maps to highlight the different views that individuals have of these and the consequent impact on technology and technology placement. Section 6 concludes with some thoughts as to how the home presents some fundamental challenges to human–computer interaction and the built environment in the age of ubiquitous and ambient computing. The twin concepts of place and technology are brought together in a discussion of the implications for design that the experience of undertaking the work has raised.

2. Background

There are few words in the English language that are filled with the emotional meaning of the word 'home'. Eggen et al. (2003) found terms such as cosiness, control, security and 'doing your own stuff' were key characteristics in defining 'home'. However, not all languages have a word with these connotations. 'Casa' is much closer to 'house' than to 'home' as is 'Maison', and in Hungarian the 'Haz', almost always refers exclusively to the physical structure rather than the emotional space (Csikszentmihalyi and Rochberg-Halton 1981). The Greek word *Oikos* includes not just the concept of space, or place as 'home' does, or social networks, as 'household' does, or a family-oriented work as 'domestic' does but all of these. The particular place that is the focus of our work, then, is Oikos. It

includes the physical space of a house or apartment, extending out into virtual spaces through technologies.

Homes are not static. They change in 'real time' through re-decoration and maintenance and they have changed radically over the years from the industrial revolution to the housing estates of more modern times. Architects create the basic space of homes, but not always successfully. A major objection to the apartments of the first tower blocks in the UK was the lack of space to accommodate kitchen appliances as the architects had assumed that the tenants would not own the latest type of kitchen equipment (Attfield 1999). Another example was 'open plan' where the intention was to create an integrated, flexible, and efficient space (Burnett 1978). However many householders objected to these open spaces because they felt they lacked privacy and consequently altered the homes themselves, adding a wall between the dining and sitting areas or forcing a table and chairs into the kitchen even though the architect had 'deliberately' left no room for them (Alderson 1962). This appropriation of the space by homeowners is a familiar and on-going part of modern life.

Many authors over the years have made the important distinction between space and place. Harrison and Dourish define place as the space plus the meaning and emotions attributed to the space by people living in it (Harrison and Dourish 1996). Place includes the activities that people undertake and the technologies that they use to carry them out. It also includes the characteristics of the people and the objects that they have in their homes. Edward Relph's classic monograph (Relph 1976) has a definition of 'place' that includes space, activities, meanings and affect. Brian Lawson quotes Aldo van Eyck in 1962 'Whatever space and time mean, place and occasion mean more.' (Lawson 2001, p. 230). Understanding the relationship between space and place in the home is therefore vital. Put a dining table in the room and it can become a dining room, putting a double bed in a room can make it into a bedroom (De Mare 1999). The home is a key site in the social organisation of space, it is where space becomes place, and where family relations and gender and identities are negotiated, contested, and transformed (Short 1999). Space in the home is something that is negotiated over, perhaps only once when the family moves house, or on a daily or hourly basis (Giddens 1984; O'Brien et al. 1999). Therefore, the home cannot be seen as a static entity but more as a free flowing expression of the householder's feelings towards it.

Activities are often foregrounded as ways of describing the home. Venkatesh (1996) for example charts the developments of various centres, or 'sub-environments'. From the activity centres associated with home automation in the 1950s, through entertainment, work, and communication centres of the following decades to modern home centres for shopping, family interaction, information and learning. Crabtree and Rodden (2002), also focus on the idea of a centre where various activity patterns can be seen. They talk of ecological habitats, activity centres, and coordinated displays. They say that there are media

sites in the home, which act as conduits for general awareness, communication and information management. Frequently augmented with other artefacts such as notice boards, address books and the like, these spaces, they say, are very important to the functioning of the home (Crabtree and Rodden 2004). The way that people undertake activities in the home continually evolves as new technologies emerge. For example many domestic chores changed when electricity ushered in the era of washing machines, electric cookers and electric irons. However, the houses that these new technologies went into, were very often not designed for the washing activity and so the storing of dirty laundry, the washing, the drying, and the ironing and folding, as well as the storage of these appliances was relegated to empty corners of different rooms.

If we are to truly understand the place of technology in the home then we should not forget that many artefacts belong not just to the home but also to individuals. Not all of those artefacts are loved and treasured as many of us have something in our home not because we like it but because it holds sentimental value or was given to us as a gift. Therefore, artefacts are not neutral in the ordinary sense of the word; they do not have a universal, unanimously approved meaning (Bourdieu 1984). We would claim that this may also be true of the ecological habitats, activity centres and coordinated displays. Our work suggests that different household members have different views of these settings and that this has an impact on the technology in these spaces. The history of an artefact is also important. In a study by Silverstone et al. (1992) artefacts could be traced throughout their lifecycle in the home. They found that this tracing could provide information about the moral economy of the household, raise questions over age and gender, and point to the visibility or invisibility of technologies within the household. They also comment that families will fight over certain technologies and that control over a technology is important.

Forty (1986) tells an interesting story about how the sewing machine was changed for the home. Faced with a massive downturn in commercial sales Singer and other sewing machine manufacturers tried to sell to the home. However, they failed to make any inroads into this market until Singer realised that they needed to create the impression that the place for a sewing machine was in the home. They first of all tried to advertise the machine by placing it in the setting of the parlour, without changing the machine itself. When this failed they realised they had to design the machine to fit into the home setting. They did this by making the machine smaller in size, lighter in weight, and giving it a more elegant design (Forty 1986).

Manufacturers of home computers did not, until quite recently, do as Singer did and change the machine; they merely changed their marketing. Home computers were sold to people in the 1980s as a way of working at home and helping to educate and entertain children. However, enthusiasm for this idea levelled off and Murdock et al. (1992) found that people were disillusioned with the early computers they bought, as the PC quite singularly failed to live up to the

marketing hype. Silverstone et al. (1992) and Venkatesh (1996) however commented that computers had in fact failed to find a '*place*' within the home. With the take-up of wireless broadband and lap top computers the constraints on place are lessening, but we still await the real design shift that will take the lap top away from its roots in the early 1990s IBM 'ThinkPad'.

3. Studying technology use at home

The features that make the home a place – its people, their activities, the technologies, the physical spaces and the social, emotional and semiotic characteristics – make it a difficult place to study. There have been many different types of studies on the home that have been conducted from many different perspectives. For example, anthropological studies that focused on the 'tribal' house or on exotic domestic spaces (Cunningham 1973; Douglas 1972; Kent 1990). The home computer and other technologies have been studied from the perspective of domestication (e.g. Silverstone and Hirsch 1992; Stewart 2003; Kjaer et al. 2000) employing theories of consumption and appropriation. O'Brien and his colleagues (e.g. O'Brien et al. 1999) tend to adopt a sociological perspective, as does Harper (Harper et al. 2001). However, many researchers have commented (Harper 2000; Stewart 2003; Hughes et al. 1998; O'Brien et al. 1999) that some of the methods used by sociologists such as ethnography may not be suitable for people's homes and that it may have some limitations. Crabtree and Rodden (2004) have argued the same care should be taken when using workplace methods in the home setting. Junestrand et al. (2001) come from an architectural background and introduced the concept of using design patterns (following Alexander et al. 1977) to studying the possibilities for future homes. Another mode of involvement of people in their homes is exemplified by the 'cultural probes' of Gaver and Pacenti (1999). Cultural probes were designed to help designers in their efforts to pursue ideas for experimental designs. Hindus et al. (2001) and the wider Casablanca project team used several methods, such as ethnographic interviews, focus groups and marketing consultants to inspire their team-led designs.

Our approach to studying technology use in the home was to undertake a series of contextually grounded activities known as the Home Workshop (Baillie and Benyon, in preparation). Previous studies of the home have tended to gather data mainly or solely from the adults in the home, therefore, one of our key requirements was that we had to find methods that would directly engage children in the study of technology in the home, as theirs was a vitally important voice. We were inspired, guided and informed by the above studies but also the techniques from participatory design (PD). PD encourages graphical expression in the form of sketches, storyboards and collage and can be effective before designers know what kind of device or service is required or desired. We therefore believed that employing some of these techniques in the home with children and families could prove successful. The Home Workshop consisted of

Table 1. The methods and focus for each of the home workshop sessions.

	Focus	Methods
Preparatory session	Planning and collecting family data	Telephoning families, gathering equipment: stationary, video camera and tapes
Session one	Investigate current problems and future possibilities	Technology Tour Representations of emerging technologies Scenarios
Inter-session activities	Collecting data in-between sessions	EU (exploring use) notes
Session two	Contextualizing ideas for the home in the future and daily life	Informal interview Materializing ideas for future technologies
Session three	Sharing ideas across families Modifying and elaborating designs	Critique Redesign

three visits to the participants' homes and some inter-visit activities. The aim of each part of the workshop is outlined in Table 1.

Five households in central Scotland agreed to take part in the study. The households that volunteered ranged from a family with two young children to a single woman of eighty-four (see Table 2 for a full list of the participants). Some of the participants lived in affluent areas while others occupied modest public-sector accommodation. Their educational attainment was varied with some still at school, some having left school at sixteen and some with a higher degree. All the families gave permission for the data collected as a result of the workshops to be published. To preserve anonymity, pseudonyms have been used.

Table 2. The families who took part in the home workshop sessions (Baillie et al. 2003, p. 85).

Identifier	Who		Age	Occupation
Cook	Robert	Father	50	Lecturer
	Sue	Mother	45	Housewife
	Dianne	Daughter	10	School pupil
	Tarquin	Son	7	School pupil
Petric and Naysmith	Catherine	Partner	25	Recruitment consultant
	Gordon	Partner	29	Administrative officer
Suttons	Emily	Wife	70	Retired teacher
	Peter	Husband	72	Semi-retired builder
Smiths	Mike	Father	46	Joiner
	Barbara	Mother	44	Catering assistant
	Simon	Son	15	School pupil
Reilly	Agnes	Widow	84	Retired cook

The focus in this paper is primarily on the 'technology tour' part of session 1. This is a technique that was developed and tested in two trial home sessions, one in Denmark and one in Scotland (Baillie and Petersen 2001). Mateas et al. (1996) also undertook tours of homes, focusing on the layout of space and the location of artifacts. Stringer et al. (2006) were concerned with the installation of domestic sensor technologies. They focused on people's understanding of technologies, gendered relationships and how the technology had been acquired. The focus of the technology tour described here is on place, placement and technology. In the final section we return to the experience of the Home Workshop and put the technology tour into the perspective of place and technology design for the home in both the present and the future.

4. The technology tour

The technology tour involved two tours; one with the whole household and the other with only the individuals. In three homes the household tours were first and in the other two homes the individual tours were first. During the tours the researcher asked about possible conflicts in ownership of as well as the history, flexibility and motivation for the physical organisation of spaces and technologies. The researcher asked the participants to describe problematic situations they had experienced with the technology and they were asked to talk about the activities they undertook whilst using the technology. Thus the main thrust of the technology tour revolves around four key issues: what technology is present in each room; where it was placed; who uses the technology; what activities it supported. Inevitably such a focus threw up a lot of interesting and related ideas. No artefact was excluded from the tour and this resulted in toys, kettles, sewing machines, lawn mowers, telephone books and other assorted media and artefacts being included.

The technology tour resulted in 12 h and 15 min of videotape and 41 pages of typed up additional notes. The videos and notes were transcribed in their entirety. These transcripts were put into the analysis software 'Ethnograph' that helps with coding and collating of concepts. A snapshot of the transcripts during coding can be seen in Figure 1. The data was then thoroughly analysed using grounded theory. Grounded theory presumes that whatever framework or methods were employed in the field, new ideas and issues will arise in the analysis and the theory allows for these to be incorporated into the analysis and findings. The part of grounded theory that was used was the constant comparative method (Glaser and Strauss 1967). The method has four stages; comparing incidents applicable to each category, integrating categories and their properties, delimiting the categories, and writing theory. Fifty seven code words were found in total as result of the first phase of the analysis, as the analysis continued the number of code words gradually reduced to ten and finally to eight. These are summarised in Table 3.

Of course each of these themes could be explored at length. In this paper, however, our focus is on place and placement. Privacy and control are strongly

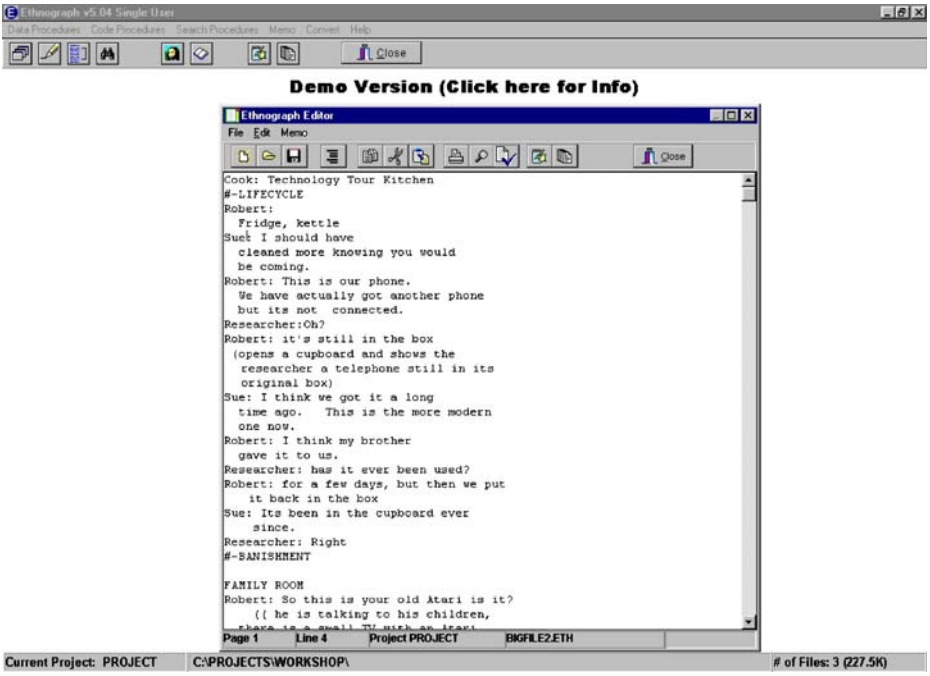

Figure 1. Snapshot of transcription during coding.

related to place and placement which gives rise to the overall concept of place in the home. The other themes of learning, utility, interaction, cost and lifecycle are more focused on technologies. We return to the interaction of place and technology in the concluding section.

The strength of a field study is in its ability to give rich descriptions of social settings, and the data provided in Section 5 gives this rich description of five families in Scotland and their views on domestic technologies. This highlights the different views of different family members, conflicts of perceptions of places and spaces and misunderstandings of each other's knowledge and abilities. Our primary aim is to present the findings of the tours in a way that is useful to designers. We encountered some concepts that were similar to those uncovered by other researchers such as Mateas et al. (1996), Stringer et al. (2006), O'Brien et al. (1999) and Crabtree and Rodden (2004) But we have also uncovered many different classifications of issues and it is these that we try to highlight in our analysis.

4.1. A typical technology tour

In order to give a flavour of the process we will describe a typical tour. This is the tour of the Smiths' home. The Smiths were a family of three living in a public sector apartment (council house) with two bedrooms, a lounge, kitchen and

Table 3. The key themes found as a result of the analysis and example quotations.

Code name	Number of times the code occurred	Example quote
Place and placement: This encompassed the participants' thoughts on how they currently used the different spaces in the home and how that affected the use of the technology within it	157	Barbara: It's a digital TV. Researcher: It's positioning there? Mike: Its just (.2) its aye been there, they've all been there. Researcher: Do you mean all the televisions? Mike: Aye
Learning: How the participants learned how to use the devices in their homes	82	Dianne: I don't know how to use the printer or the scanner. I have tried but there is this one bit that I can't...I don't know how to go on and find anything...anywhere different or anything
Utility: the utility of the device from the participant's perspective	78	Sue: The dryer is a bit ancient, the door doesn't stay on properly, but if you get it right then you can get it to work Researcher: So how long has it lasted for? Sue: Oh a long time (.2) must be probably about fifteen years
Control: control over a device or space	76	Robert: They use it for games. It's old and doesn't work very well. Dianne: Hmmm. Tarquin: Yeah. But it does work! Dianne: Yeah, It's attached to the TV and Dad sometimes wants to watch TV. Robert: That was another reason of course if I wanted to watch the TV news...and they wanted to play games...
Interaction: appropriate or inappropriate choice of input devices or interaction method	65	Emily: The TV is difficult to tune because of the small...what do you call it, the thing you hold ((Emily is pointing at the TV and making a shape in her hand)) (.15) the remote control ((laughs and puts her head in her hands)). To tune in the TV takes forever
Cost: the running costs of a device	47	Gordon: It is quite limited and they've got their own sort of search engine and all the rest of it, which takes too long to find sites. It's just not worth the time plus you are sitting with your phone (.) running up your phone bill

(*continued on next page*)

Table 3. *(continued)*

Code name	Number of times the code occurred	Example quote
Lifecycle: the history of the device	41	Emily: It took me nearly a whole day, there were two bits of plastic sticking up that way ((she is miming what she was trying to do with the phone)). I tried to fit the batteries in. I tried for ages and then just thought I am fed up with this. I'll need to get someone to try and fix-it and I just slammed it down like that ((mimes a slamming down of her hand onto the phone)) and it slotted right in
Privacy: whether the device had any level of privacy and what would be private in the future	20	Mike: I'm not bothered about privacy. What's going to be private? Nothing's going to be private in the future anyway is there?

bathroom. They were a family that was seemingly comfortable with technology and owned a digital TV, PC and used mobile phones.

The tour commenced in the living room. The family began talking to the researcher about various artefacts in the room. The researcher was directed to a new television in the corner of the room.

Barbara: It's a digital TV

Researcher: It's positioning there?

Mike: Its just (.2) its aye been there, they've all been there.

Researcher: Do you mean all the televisions?

Mike: Aye

Researcher: Would you ever consider moving the position?

Mike: No! Would have to change the room.

It can be seen from this comment above that the positioning of the television is historic i.e. a television, in this family's home, is always placed in this position in the living room. The father and son both further commented that the room was set out so as to facilitate viewing of the television. Barbara (mother) seemed put-out by this suggestion and tutted and sighed while Simon and Mike were saying this. She very clearly did not want anyone thinking that the livingroom was laid out for the TV. Therefore it was not just the presence of the TV put the placement of furniture in conjunction with the TV that had negative connotations for the mother of this family. Figure 2 shows the consolidated map of the Smiths' home.

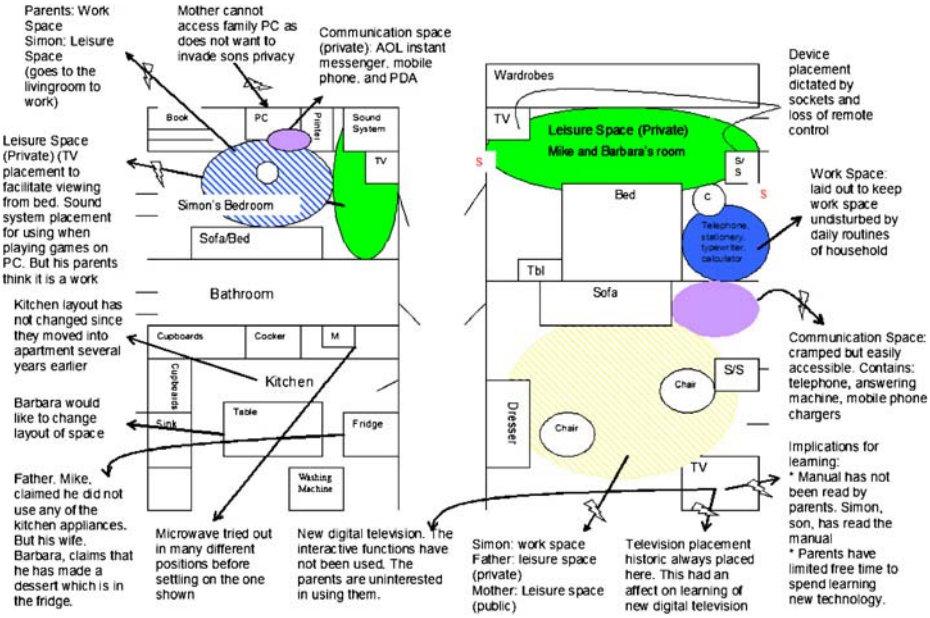

Figure 2. Smith household consolidated map.

At the bottom right of the figure it can be seen that the room does seem to have been set out for this purpose as all the furniture was orientated towards the television. We then discussed the use of the television and how they had learned how to use it.

Researcher: How did you learn how to use the TV?

Simon: I read bits of the manual

Researcher: Did you find it useful?

Simon: Aye, in some bits.

Barbara: I jist sort o roamed around the channels, flicking the buttons.

Mike: I did that tae. I've no got time.

This, and other excerpts, showed that learning how to use a device in the home can be quite problematic. For example, the children in the Cook family did not know how to use the printer or the scanner as no-one had shown them how to use these devices. The devices were set to only automatically offer a walkthrough of the device the first time they were used, after this it was difficult to know how to access such a walkthrough and even though the children had looked they had found no information on how to activate a walkthrough. In another household, Petric and Naysmith, the young couple had not read the user manual and the device did not have a walkthrough introduction but advertised that it was ready to

use and required no learning, this turned out not to be the case. It could be that the techniques in HCI that have been developed to assist the learnability of a device in the workplace may prove to be problematic for the home: as no trainer or IT assistance is available, different people in the household come to use the device for the first time at different stages in the devices lifecycle, and not reading the manual could be said to be even more likely in this environment. This non reading of the manual in the home has also been found by other researchers (Kjaer et al. (2000).

We then moved on to the kitchen. The Smiths have not changed the layout or decoration of their kitchen since moving in, much to Barbara's chagrin. Barbara had many ideas about how to change the kitchen but none of these had been implemented. It was not the cost that was preventing the changes from taking place, but the feeling of ownership. This family did not own their own home but rented, therefore this could be affecting Mike's view of his home place. Mike (father/husband) claimed (as he had in his individual tour) that he did not use any of the technologies in the kitchen. However his wife (Barbara) opened the fridge and pointed to a home made dessert. It was quite clear from her inferences that he had made the dessert, and he looked quite put out by her suggestion that if it wasn't his, then she would eat it. Perhaps Mike did not want to admit to using any technologies in the kitchen.

This claim was perhaps rooted in a finding made by Csikszentmihalyi and Rochberg-Halton (1981). They found that people's relationships with objects in their homes were to a certain extent 'scripted' by their cultures. That is, how we react to objects and our feelings towards them have already been influenced in advance by the social milieu into which we are born. The father even encouraged his son to leave the kitchen at this point so that he would not hear him chatting about the technology, he did this by asking him to go and get something, even though it was clear that the object was not needed. This then clearly brings into question some of the existing theories on gendered technologies in the home that other researchers have mentioned (Livingstone 1992; Stringer et al. 2006). As it would seem that some men believe that they should claim that they do not use any of the technology in the kitchen or gendered devices (e.g. washing machines, tumble dryers and so on), even if this is not true. We would therefore point to the strength of the technology tour in uncovering everyone's views of the home space as these can go some way to showing whether there is truly a gender bias or not.

Barbara had experimented with the placement of various devices in the kitchen. She said that she had tried out the microwave in various places. Therefore the microwave's position was not haphazard, but was in a well thought out place. Barbara mentioned at this point that she would like to have more access to the family computer but her son said that she did have access. Later in her individual tour she elaborated on this point saying that she felt that she was unable to access it due to its placement in her son's bedroom, as she did not want

to invade his privacy. Simon Smith was also found to have quite a different view of the home than his parents as illustrated in Figure 4. From this Figure it can be seen that Simon only uses the toaster and the kettle in the kitchen. Simon does not make his own meals or take part in the preparation of food in the home. His mother comments that he uses the microwave however he disagreed with her and said that he only used the kettle and toaster.

We then moved on to the parents' bedroom where they showed the researcher the different spaces and the technology contained in the room. In his individual tour Mike had talked at length about his workspace in the room. He explained why he would not need certain devices such as a computer. He said that it would be pointless to have them as he only carries out a small amount of work at home. Figure 2 also shows that the reason for the positioning of the workspace in this part of the house is that the area remains relatively undisturbed in the daily routines of the home. The Smiths have the television and sound system positioned in different areas of the room. They explain that this is because of the positioning of sockets and the loss of a remote control.

We then moved onto Simon's room. His parents comment on how they acquired the technology to help him study and that this is why the room is laid out in the way it is. His father even jokes about putting bars on the window to keep him inside to study instead of going out to meet with his friends. Simon's bedroom does indeed create the impression that it is ideally set up for studying as his parents claim. However in his individual tour Simon pointed out that it is not ideal because he lacks adequate light and he prefers the more social atmosphere of the living room. In his individual tour Simon talks a lot about the layout of his room and the technology in it. In this excerpt we discussed the positioning of his PC:

> Simon: I would rather have it over there ((he is talking about his PC and is pointing to the same wall but further along to the left)) and the TV and that over there.
>
> Researcher: That would mean that your PC and printer would be together under the window and your Television and sound system in that corner.
>
> Simon: Aye, that's what I would like. That would be ideal.

The result of this rearrangement would be a clearer distinction between Simon's leisure and working spaces in his room. The reason that he does not move his PC at the moment is that, while there is room for his PC under the window, there is no room for the attendant artefacts such as the printer. It became clear after the tours that each of the Smith family members had differing views of the same spaces, therefore three separate maps and one consolidated map was required.

5. Spaces and places in the home

During the analysis of the technology tours, it became clear that our participants were, naturally, dividing their home into different spaces. The identification of these spaces came about in the following three ways: The residents actually stated that this was a particular type of space; the activities that the residents said that they undertook in this space made it a particular type of space; the words they used when trying to describe the space. The four spaces identified were:

- Leisure (Private) where householders relaxed watched TV, played games, chatted etc.
- Leisure (Public) where householders entertained visitors to their homes.
- Communication where telephone(s), telephone directories, personal address books, calendars, pens and paper (for jotting down telephone numbers, messages etc) were located.
- Work where a space was considered or viewed by one or more participants as a place where work activities were carried out.

We call these 'spaces' rather than 'places' here because the sense of place is a personal feeling, an affective bond between a person and a physical space (Tuan 1977) that includes space, activities, meanings and affect (Relph 1976). Since in most of our families there was rarely a consensus over the places in the home it is more suitable to talk about spaces in these more abstract discussions. Others have also identified various spaces in the home. Venkatesh (Venkatesh 1996) distinguishes social and technological space, Mateas et al. (1996), identified, command and control, hang out, social event, work and private spaces and Crabtree and Rodden (2004), focusing on communications in the home, identify ecological habitats, activity centres and coordinated displays.

To help with the understanding and analysis of the spaces, maps were produced for each home and each person's perspective on the home. Each of the spaces was colour coded and labelled on the maps. Diagonal 'lightning bolts' are shown on the maps to indicate disagreement over the perception of space by different people. Beyer and Holtzblatt (1998) use models, which they call physical models, in a similar way to understand their customers' views of their workspace.

5.1. Workspace

Workspaces were sometimes of the traditional office type in that they contained a desk, chair, set of drawers, stationery, PC, printer etc, all neatly arranged in a small space. This type of workspace was found in Simon Smith's bedroom (see Figure 4), the dinning room at the Cooks (see Figure 3) and in Mike Smith's bedroom (see Figure 2). However, breakdowns in these workspaces can occur, as the other household members do not always universally acknowledge them. For example, Simon Smith's parents thought that they had helped him to set up an

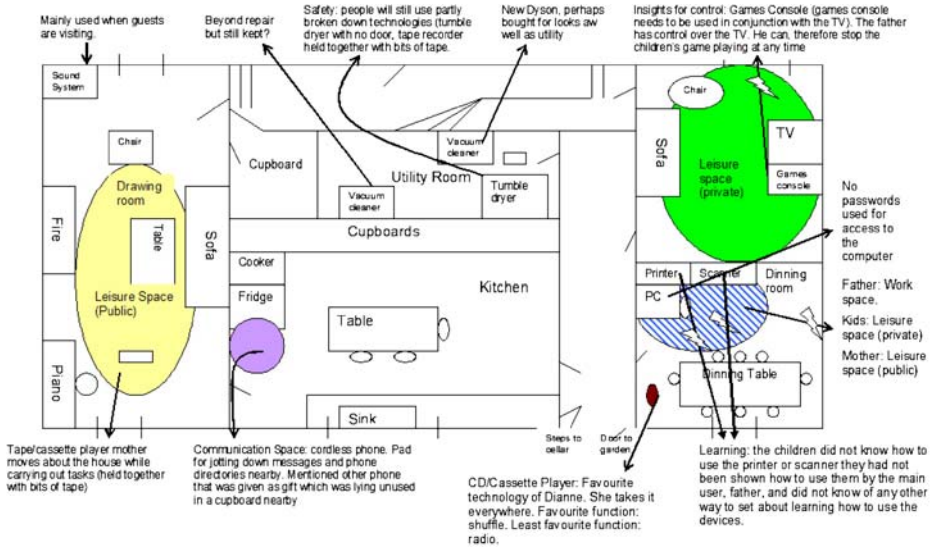

Figure 3. Cook household consolidated map.

ideal small workspace in his room and they had helped him furnish it with all the tools necessary. However, Simon actually saw this space as two separate spaces: a communication space and a leisure (private) space. Simon, saw the living room as his workspace as this is where he studied.

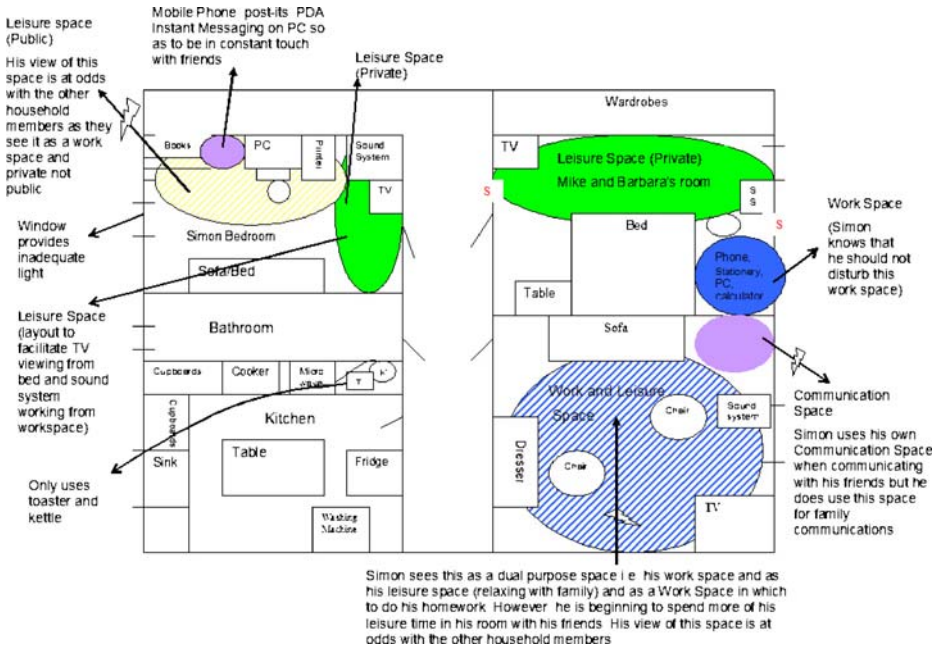

Figure 4. Simon Smith's view of his home space.

In another case the situation was even more complicated by three different parts of one family disagreeing on the same space (see Figure 3). The father thought that it was universally acknowledged that a small space in the dinning room was his workspace (see Figure 3, bottom right) however, the children thought that this same space was a leisure space and the mother thought that this and a larger adjoining space were for entertaining guests and giving dinner parties. She commented that she couldn't stand all this clutter (e.g. the office equipment and the games) 'ruining this space'.

This led to several interesting breakdowns in the use of the technologies that inhabited these Work Spaces. Robert Cook said that his workspace was 'his space' but that since the family only had one PC he was happy for the children to use this space and the equipment in it (e.g. scanner and printer) for their schoolwork. He further commented that the children knew how to use the equipment in this space. This was agreed by all of the family during the household tour. However, when undertaking the same tour with the individual children they commented that they did not know how to use the printer and the scanner because no-one had ever shown them, and they did not know where there where any instructions.

> Dianne: I don't know how to use the printer or the scanner. I have tried but there is this one bit that I can't...I don't know how to go on and find anything... anywhere different or anything. And I don't know what I am supposed to do next. So I haven't tried to use them for quite a while.
>
> Researcher: Did you look for any instructions?
>
> Dianne: Kinda, but, well, but actually I don't think it did have any kind of instructions.

The use of the space combined with the lack of instructions available on the computer had an effect on the use of the technology in this space by the children. It could be that this situation arose because of the origins of the PC, in that they were originally intended for the workplace (where training and support on the use of various devices is readily available) but now also inhabit the home place. While some adjustments have been made to the appearance of some of these machines (e.g. the new offering/branding of PCs as 'multimedia centres') the very different learning environment in the home does not seem to have been considered. This very danger was highlighted by Gaver (2001) when he commented that as technology moves from the office into our homes it will bring other workplace values such as efficiency and productivity and that this could be at the expense of other possibilities.

In the case of Simon's workspace, he did not see it as a workspace but as a Leisure and communication space and he saw the living room as the place for work. He was therefore happy for others to use the space and the technology in it, especially if he was out or at school! He said this during the household tour and the individual tour. He thought that this part of his bedroom was public space, as

this was where the family PC was placed. He believed that in order to gain the benefit of having the PC placed in his room, rather than in the living room, he had to be willing to give up a little of his privacy, which he was willing to do. The reason for his preference for having the PC in his room became even clearer when we discovered his communication space (see Figure 4 and the discussion on communication spaces). Barbara (mother), however, did not want to invade her teenage son's privacy and this meant that she did not enter this space and learn more about the PC even though she wanted to. Therefore the placement of the PC in this home had a direct consequence on its use.

The traditional office type workspace was not the only type of workspace found in the home. In three of the households the women adults saw the kitchen as a workspace (Agnes Reilly, Sue Cook and Barbara Smith). However, in the other two households (Emily Sutton and Catherine Petric) the cooking and cleaning were shared and the women did not see the kitchen as a workspace. This viewing of the kitchen as a Work Space had resulted in the first three women having very definite opinions on how such a space should be set out, what devices it should contain and where they should be placed.

Two of the households in which the kitchen was viewed as a workspace were houses not owned by their inhabitants, in both of these cases the women commented on their unhappiness about the layout saying that this meant that they did not have enough control over the placement of their devices (see Figures 2 and 5).

In the following excerpt, Agnes Reilly remarks on this issue:

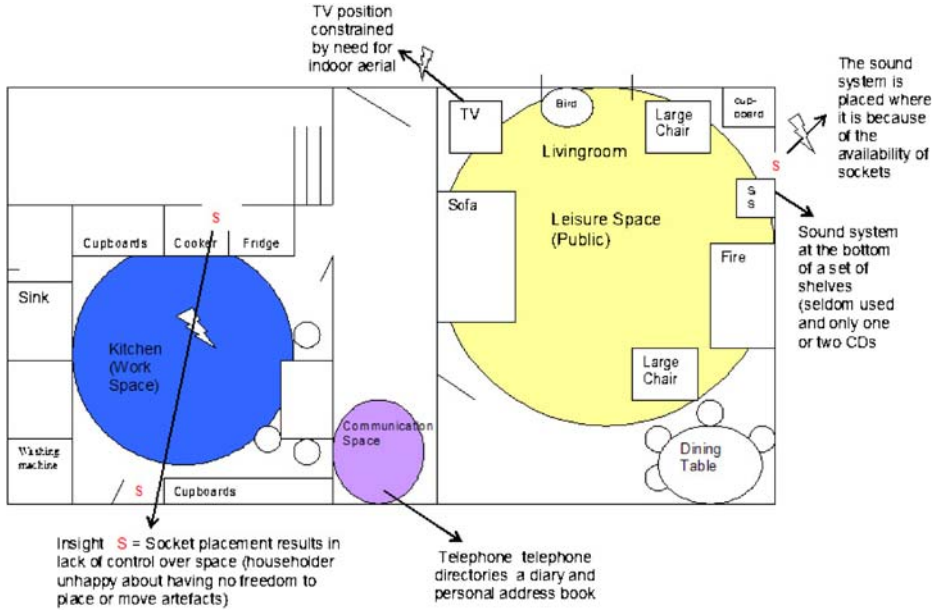

Figure 5. Agnes Reilly.

> Agnes: I don't like the layout, I don't like where the devices are, they never used to be in the positions there in now. You can see it's all been set up for the sockets. See they're stupid there ((Agnes is pointing to some sockets next to the door to the garden)).
>
> Researcher: Did you decide on this?
>
> Agnes: No. They were just put in there they never used to be there. It's only in the last year that those sockets have been put in. They never asked. I would have had some on that flat wall instead of the curved wall, that's where my microwave used to be.

Workers from the local authority had recently visited her home and changed the placement of the electrical sockets in her kitchen. Agnes then had to rearrange all the electrical equipment in her kitchen to suit these sockets. She said that she had got rid of her microwave as the only place that she could have put it in the new layout was next to the sink, something that she thought was unacceptable and potentially dangerous. She was very upset about this and felt that she should have been consulted about the placement of the sockets when they were installed. She had been happy with the previous placement of the microwave, which had been on a counter at a safe distance from the cooker and the sink. Barbara Smith (who lived in the other local authority home) complained of a similar lack of control over the space. The kitchens in both of the local authority homes had limited or no personalisation, this was in sharp contrast to the other households in the study who owned their homes and had personalised the kitchens to suit their needs. This lack of personalisation was also found by Miller (1987) when he undertook a study of public-sector tenants' homes. Csikszentmihalyi and Rochberg-Halton (1981) reported in their study that when elders were moved from their own homes into sheltered housing they wanted to bring their furniture and objects with them. The US Government missed the importance of the objects as a means of establishing a sense of personal place and continuity in an otherwise new impersonal environment. We would go further in that we believe that it also affects the technologies that are acquired for each space and our interactions with them once they are in place.

The other important point to note here, as regards the future and concepts of ubiquitous computing is the importance of the power socket in the placement of technology in the home. This was something that was found in all of the homes. Even the elderly couple who had completely remodelled their house to suit their needs complained about this tyranny and looked forward to a day when technologies would be free of power cables:

> Emily: I would like to place devices wherever I want without wires and cables everywhere and be able to move them easily.
>
> Peter: You could move one to the toilet!

5.2. Communication space

Specific Communications Spaces where found in all of the homes. These spaces contained a myriad of artefacts connected with communication such as: diaries, telephones, mobile phones and chargers, telephone directories (publicly available ones e.g. British telecom telephone directory for the local area, and personal ones), post-it notes, calendars and in the case of families with children, school notices. Communication spaces could be seen as being similar to Elliot et al.'s (2005) Information spaces and Crabtree and Rodden's (2004) ecological habitats or media spaces. They comment that these are known locations in the home where such shared information is kept and announced to other household members. We also found this and that everyone in the household knows where a communication space is from very small children to adults. In one home however, there were not just one but two communication spaces. Simon Smith (a teenager) had his own private communication space that he used for communicating with his friends, organising nights out, and just to chat. He still used the family communication space for telephone calls to his grandmother and to let his mother know about school events. Simon had a lot of technology in his communication space for staying in touch in his friends e.g. PDA, mobile phone, IMS, and email (see Figure 4). Thus ensuring that he never looses touch!

It is interesting to compare this with the younger Cook children who did not, as yet, have their own communication space and only used the family one. Perhaps as children get older they start to create their own spaces in the home. The maps help to highlight this, for example, in the Cook family, there was only one space in which the children disagreed with the use of a space. However, in the home with a teenager there was disagreement over three spaces and this in a house with only four rooms! Crabtree and Rodden (2004) suggest that the computer based devices and other media in these places could be linked. However, our research would suggest to designers that there may be problems with this concept, as families with teenagers may not welcome this linking. If we are to start linking various devices in the home then we must have a research agenda in place within HCI and CSCW that enables us to investigate the importance of understanding of how such linking and clustering devices would affect all household members' views of their shared space. This should in turn reveal much about what the impact might be of current and future technology in such spaces.

5.3. Leisure space (Public)

When people viewed a space as being a public leisure space this was found to affect what technology was in this place and where it was placed. For example the Suttons who were an elderly couple had completely altered their home space to reflect their activities once they had retired and their children had left home. They said that now that they were retired they like to spend most of their days on

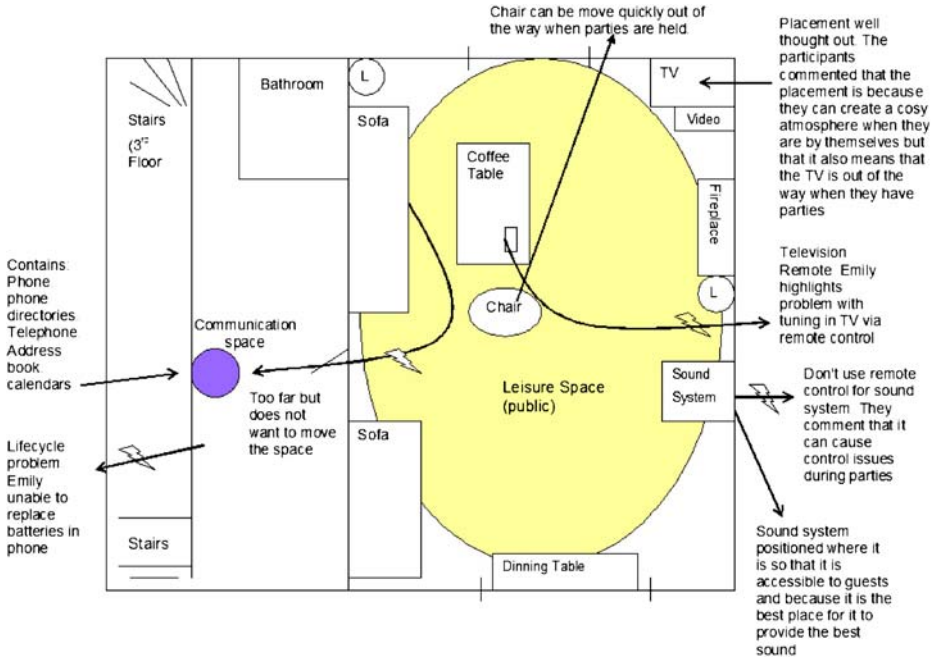

Figure 6. The Sutton's second floor.

the golf course (there are three golf courses nearby and they are members of two of them) and to go out for dinner to a friend or relatives home or a restaurant, thus they rarely cooked themselves. They also liked to have a lot of parties. This lifestyle had a dramatic effect on the technology they owned and its use (see Figure 6). On the ground floor the large kitchen was taken out and a small bedroom and a small kitchen created instead. This resulted in them acquiring a combination microwave and fan assisted oven, as it was a more efficient use of space. They also altered the second floor of the home taking out two bedrooms and making this into a large lounge for entertaining guests. The placement then of their technologies in this room was very important to them. The television was in a specific corner that created a nice cosy atmosphere when they were at home alone, but was also handily out of the way when they had guests. The sound system in the room was in the centre and the speakers placed in the four corners so as to achieve a surround sound effect. They said that this placement was also so that their friends could put on tracks of music as well.

They commented that the remote control was a key issue regarding their friends' willingness to put on music. If they used the remote control they found that they were seen as being in control of the music, however, they wanted their friends to feel free to select music and put it on. They therefore decided to put away the remote in a cupboard underneath the sound system when their friends came round. They found that this had resulted in them almost never using the remote control.

5.4. Leisure space (Private)

Private leisure spaces were found in all the homes. All the adults in our studies agreed upon the private leisure spaces. Some homes were too small to be able to separate their private leisure space from their public e.g. the Smiths and Agnes Reilly. When there was space to separate these spaces even if this was just by the arrangement of furniture, as in the Sutton home, this was done. This affected the technology that inhabited those spaces.

We found that there was always a television in the private leisure spaces but in a public leisure space there was not, this was reversed when it came to music with a sound system or other musical instrument (e.g. piano) always being present in a public leisure space. This placement affected the technology in that some parts of the technology were not used e.g. the remote control for the sound system. In another case it could be said to have affected the learning of a technology. Simon was the only one in the family to have read the user manual for the new digital television. Could this have been related to his view of this space in that it was part of his normal routine or activities in this space to learn about new things? Tolmie et al. (2002) talk about the importance of routines and that these are more important than artefacts. We agree but also think that there is in fact other facets to this relationship, for example, if we have a particular routine of learning in a space then do we more readily acquire knowledge of new artefacts in that space? Barbara and Mike in contrast who saw the space as definitively a Leisure Space and somewhere were work in a sense was not allowed did not learn anything new about the digital television and just used it in the same way as the previous television.

Another interesting perspective was the time zoning of this and other spaces in the home and its affect on technology use. During the household tour in the Cook home the father claimed that the children did not use an old games console (Atari) because it was old:

> Robert: So this is your old Atari isn't it? ((He is talking to his children))
>
> Tarquin: Yes
>
> Robert: They use it for games. It's old and doesn't work very well.
>
> Dianne: Hmmm
>
> Tarquin: Yeah. But it does work!
>
> Dianne: Yeah, It's attached to the TV and Dad sometimes wants to watch TV
>
> Robert: That was another reason of course if I wanted to watch the TV news... and they wanted to play games....

The father had claimed that the games console was not used because it was old and didn't work very well when in fact it was used and did work well. It was the

clash over the use of the technology in the space at that particular time that impacted on the technology.

We found that there was seldom a haphazard placement of a device in the home, even in new homes. For example, Catherine and Gordon had been given a gift of an old television set to use until they could afford a new one. They said that it had been placed where it was haphazardly while they were decorating.

> Catherine: It's on the floor there because we're decorating and it's so old it doesn't have a stand.

We surmised therefore that the television's placement was temporary and that we should wait until the end of our visits to see where the television would end up being placed. However, over the course of the next three visits (The Home Workshop has three visits, see Table 1) the television stayed in the same place, even when a new television was purchased, it was placed in exactly the same spot. Kjaer et al. (2000) made a similar finding regarding televisions. They found that householders were willing to loose features of the television in order to place their new device in exactly the place they had selected for it. The placement of devices in leisure spaces is a key determinant to the device's subsequent use.

5.5. Particular placement

As well as spaces there were two additional interesting phenomenon that directly relate to place and placement: banishment and shrines.

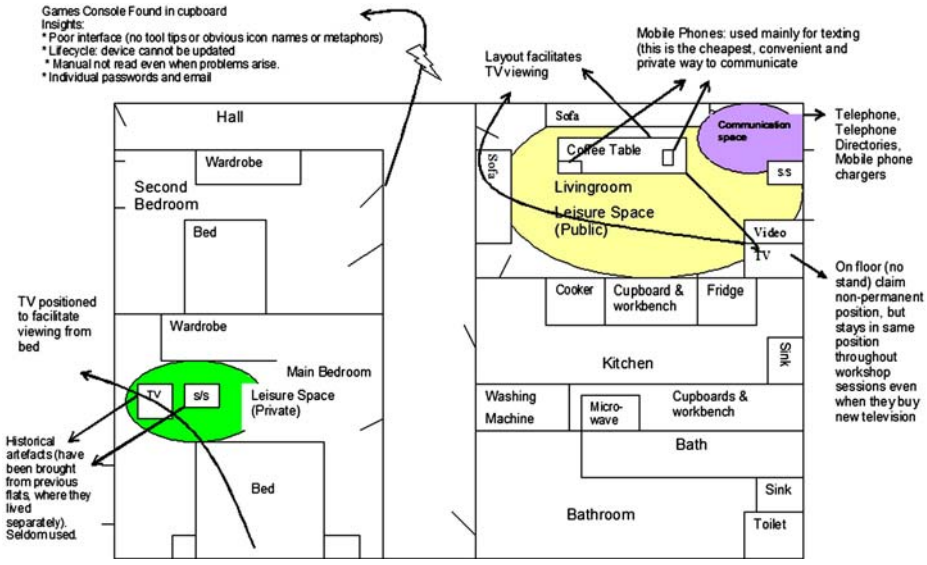

Figure 7. Petric and Naysmith.

Banished devices were found in several homes to have been placed in the deepest recesses of cupboards or in dark corners of rooms. During one tour Gordon and Catherine pointed out a games console (see Figure 7) that was less than 6 months old that they were keeping in a cupboard under a pile of other bits and pieces.

Gordon: We bought the Dreamcast over the Sony Playstation because of the Internet and e-mail access. It's pretty limited. You can only go into sites that Sega® has allowed you to. You can only use their e-mail set-up, which isn't very usable. However, for getting the Internet through your TV it's not bad.

(Catherine and Gordon are now setting up the games console and showing the researchers how they use it)

Gordon: So it is attached to the phone line and that's how it gets the Internet cause there is a modem inside the console.

((We wait for a few minutes for the modem to connect))

Gordon: So as you can see it's not exactly instantaneous!

(The main screen has loaded and Gordon and Catherine are sitting scanning it to find e-mail)

Gordon: Do you know which one is e-mail? ((He says this to his partner))

Catherine: I've not got a clue

((They spend a few minutes trying to work out on screen what the various icons stand for trying to discern which one is the email icon))

Gordon: A::hh that's e-mail there!! We only ever use it for e-mail!

They had bought this particular games console because they had wanted a PC but did not have enough money to buy one. They commented however that they had given up trying to use it and started going to internet cafes for the following reasons: the poor user interface which made using the internet and email facilities almost impossible, the fact that you could not update the system, and the unknown running costs. We also discovered other banished items in other homes e.g. a telephone, toys, a remote control and a sound system. Banishment is not usually for one reason alone but for a myriad of reasons for example, no appropriate place, poor usability, no longer fashionable, unknown running costs therefore, any researcher interested in really understanding the use of technology in the home place should ensure that they have access to banished devices and objects.

Some devices were found to be kept in their favoured place until they had more than passed their sell by date. For example, a tape recorder that was literally falling apart and was held together with tape, a vacuum cleaner that no longer

worked and an interactive toy which had to be shaken several times to get it to work. The reasons given for keeping these devices was that they had good utility and did exactly what the user wanted and had done so for a long time. Even if they did have to be shaken or have the door fitted on 'just right'. We believe that these devices should be paid extra attention as these are the champions, the ones that made it to finish line and beyond. We found that by undertaking the tour and producing the map we uncovered important reasons as to why these devices were successful.

6. Place and technology

Our aim in this paper is to sensitise designers to the design issues that matter to people with respect to technologies and the home. The rich descriptions and representations that arose from the technology tours provided in Section 5 are intended to do exactly that. However, the technology tour is only one part of the Home Workshops that were undertaken (see Table 1). In later sessions of these workshops, the participants were encouraged to envision future devices and future interactions and to critique the designs of others. This version of the 'Future Workshop' (Jungk and Mullert 1987) proved very effective in eliciting design features that people felt were important but that had not arisen from the review of existing technologies that was the focus of the technology tour.

Alongside the eight themes of the original grounded analysis of the technology tour data, three new themes became apparent; automation, mobility and personalisation. Personalisation was most apparent with respect to the colours and aesthetics of a device, but was also mentioned with respect to functions. Mobility through wireless communications was seen to have great potential in removing some or the constraints that impacted their existing technologies. Automation of mundane household tasks emerged as an important desire for new technologies over and above communication and information provision.

Other comments and insights could be analysed in terms of the eight main themes: place and placement; learning; utility; control; interaction; cost; lifecycle; and privacy. People were concerned about the lack of space to accommodate new devices but where there was space, they often had very clear ideas as to where a product might be placed. There was strong relationship between placement and product size and a general desire for multi-function devices that would save space. Learning how to use devices and products remained a major issue. People wanted learning to be more fun, and wanted to learn different functions at different times. They recognised that there needs to be opportunities for different people to learn different aspects of the device at different times. The utility of products and services remained another central concern.

Control took on some wider issues in the envisioning part of the Home Workshops. People could envisage conflicts over control and who in the family could have access to which functions. It was also recognised that there could be

conflict between the automation of tasks and the control over them by people. Interaction was desired to be much more fun, enjoyable and entertaining. Costs, particularly running costs, was an area of worry. The lifecycle of a product was highlighted as another area of concern. People were anxious that modern systems might crash on them and just stop working. Systems would need to be maintained and updated and people wanted to be able to do this quickly and effectively. Privacy was important with respect to personal privacy in the home, private and public spaces, privacy of what an individual had done using a device and with respect to security of the home.

Taken with the issues that arose from the technology tours, some key implications for design emerge for the twin concepts of space (and time), Technology and their interaction in the home. These are illustrated in Figure 8.

The take home message for designers, then, is to pay attention to these key issues and to consider how they impact on the design of products and services. In particular consider:

– *Placement*. Where is the product going to be placed in different homes. Whilst this is made easier with wireless communications, other necessary interactions (such as power) will constrain place as will the characteristics of the device such as size.
– *Control*. Who has control at which points of time is critical as is the opportunity to override others' control (e.g. parental controls) and for people to know and understand the distribution of control between people and devices. Privacy (such as password access) issues are closely related to control.
– *Lifecycle and Learning*. Using devices at home is very different from the workspace because there are no 'local experts' to provide help when it is needed. Designers need to consider how a device is learned, by whom and for which tasks such as first use, regular use, monitoring, updating or maintenance.

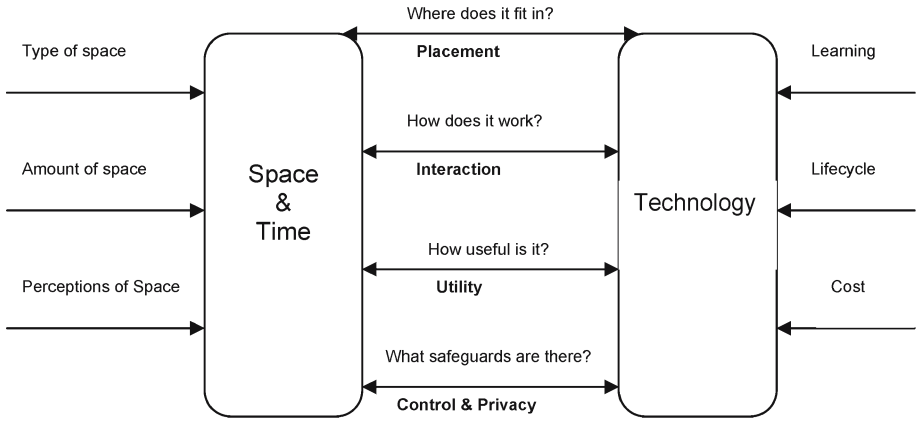

Figure 8. Key relationships of space and technology at home.

- *Interaction*. Interaction design is important and is becoming increasingly critical for devices, products and services. Interaction should be enjoyable and entertaining. There is a desire for interactions to be personalised and for devices to be configurable and flexible.
- *Utility*. The functions of a device, its cost, the cost of services provided by a device and how these functions fit in with people's lives are important to a successful design. It is not enough just to add functions, they need to be appropriate for the wide range of domestic environments.

7. Conclusions

Spaces, places and placement are critical concepts to people and their relationships with technology in the home and it can be useful to map these in order to understand people's experience of technology and place. We found that problems arise when different family members view the same space differently. Robert Cook sees a Work Space, but his children think it is a Private Leisure Space and his wife (Sue) thinks it is a Public Leisure Space. The children played games in the space, on the PC, the father worked in the space and used all the devices and the mother wanted to keep it tidy for visitors and did not see it as a space in which technology should be placed. As a direct result the children did not know how to use two of the technologies and the mother refused to use any of the technologies. We have also seen how there may be multiple occurrences of particular types of space, such as the Communication Space.

During the technology tour families would mention why devices had been situated in the positions they had. The participants could also clearly articulate whether a potential future device would or would not be adopted into the home dependent on whether or not there was an appropriate place for it. It was also found that when a participant was asked to think about an alternative place for a device, this usually provoked unease. In addition each participant viewed the device and the functions on the devices as appropriate/not appropriate depending on where it was placed.

Designers need to be aware of the issues surrounding placement of a device and what affect this has on use. Placement in the home is not haphazard and is more complex than allocating an object a physical space, it also encompasses the appropriateness of the functions, the users understanding of the device and how they will learn how to use it. Traditional views of place such as Relph (1976) and Tuan (1977) have emphasised the phenomenological, but have understated the technological. Of course technologies were not as significant in the 1970s as they are now. But the studies reported here clearly show the importance of technology as a fundamental component of place. Information and communication technologies, and entertainment technologies extend the physical space beyond the confines of the walls. In the case of the home this puts additional stress on the limited space; more activities have to compete for physical space. On the other

hand, some of the constraints of the infrastructure needed to support technologies are being removed (e.g. wireless communications).

In conclusion our analysis of the tour data resulted in several models, which captured differing views of the same space and the breakdowns that these differing views caused. In addition the technology tour provided us with an effective technique for uncovering what technology is present in each room, where it is placed, who uses the technology and what activities it supports. We found that it is vital to speak to people individually and in groups and that the technique works for all our families irrespective of age or social strata.

The place called home will continue to evolve. More technologies will become part of the home. We think, though, that the place and placement issues that have emerged from our studies will remain reasonably constant. Technology use at home involves the aesthetic, the functional and overall experiences of people. Different people encounter these in different ways, at different times. For designers the key message is to design so that people can fit technologies into their lives and to recognise the differing experiences that home has to accommodate.

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