Exploring technology influences between home, work, school: implications for managing ubiquitous technologies in the home

Geraldine Fitzpatrick and Mark Stringer

Interact Lab, Department of Informatics, University of Sussex, UK

Abstract. Understanding current issues and experiences with technologies in the home, and the relationships with work and school in how technologies are managed in the home, can be useful for anticipating issues with next generation technologies. This paper contributes to this understanding through in-home studies with ten UK households. Case data is presented that both reinforces current understandings about access to expertise in the workplace and school, and presents new understandings that further unpack the ways in which the technology in the home influenced by work and school. We also discuss the more subtle ways in which technologies get into the home, and how they are managed and maintained through people's exposure to technologies, skills and expertise outside of the home. Given the increasing interest in ubiquitous technologies for the home, as played out in next generation home automation and home monitoring scenarios, we argue that such discussions are timely reminders, raising interesting questions about how these future technologies will come into the home and how people will gain the exposure and experience to help manage them.

1   Introduction

The home is increasingly becoming a site of interest as researchers look to understand, with a view to supporting, the practical accomplishment of home 'work' and home life e.g., [1, 2]. The home is also of growing interest for other fields such as ubiquitous computing where current advances in technology open up new possibilities for augmenting and supporting social life and work in the home. To this end, various studies have sought to explore home life in different ways, e.g., [3, 4, 5, 6, 7]. Many of these studies implicitly bound the limits of their concerns to the home as an entity in its own right or consider the occupants as consumers or as managers

of family life. Others explore the relationships between home and places such as work and school e.g., [8, 9, 10].

This paper contributes to this literature around home-oriented technologies by further unpacking the ways in which the home is situated within a network of influences and relationships between home and work and home and school. While these influences and relationships are clearly bi- directional, our particular focus here is on influences into the home, and on how people's experiences and expectations derived from their work/school lives can have a powerful if subtle effect on the kinds of technologies that are brought into their homes and how they are managed there.

We explore these issues through in-home studies with ten UK households. We argue that such discussions are timely reminders and pose interesting questions for future ubiquitous technologies in the home. This picks up on some themes of influences in home life, e.g., of Venkatesh [11] and Molotoch [12] who argue for a more general socio-historical overview to explain behaviours and technologies in the home. As the field of ubiquitous computing is maturing to a point where we can seriously start thinking (technically at least) about deploying distributed wireless sensor-based technologies in 'everyday' households, where will the influences and expertise and exposure come from that will enable the people in the home to acquire and manage these new technologies, given experiences with current technologies?

The paper is structured as follows: we first discuss related work in the area of domestic technology and the effect of technology on the interplay between home and work. We then give an account of our study of domestic technology use in 10 English homes and discuss our findings with respect to the influence of work on technology in the home. Finally we discuss the implications of these findings for next generation technologies in the home.

2   Related Work

While there is a diversity of work focusing on the home, here we look at the following strands relevant to the study of the relationships between home, work and technology: the work of home life, new technologies for the home, smart homes, and the role of work and school in relation to technology at home.

There is a growing body of literature drawing attention to the sociality of home life and to the practical accomplishment of home life as a legitimate form of work. Many of these studies are oriented towards possible technical support. The research focus tends to be similar to studies of the workplace, such as: the role of artifacts and spaces for the coordination of home life [13, 14, 15]; the flow of information around the home [6]; the way that routines are constructed as a means to achieve this work [6, 34]; and the negotiation of practices around technologies in the home [6]. This type of work can be seen as taking within-home life as its unit of analysis with an implicit focus on the 'core' occupants of the home, i.e., those who are part of the family or who would describe themselves as permanent residents, and on the coordinative and informational aspects of home life. Where technologies figure in the studies it is often to understand how they help regulate home life [13] or how their use is negotiated [6, 16].

Some research has moved to the development and deployment of prototype technologies for the home, often based on findings from the above studies. Communication in and out of the home is a common theme of this work [17, 18, 7]. Other work takes more of a 'ludic' perspective, as with Gaver et al's drift table [19]. Crabtree et al [20] also argue for a focus on the ludic aspects of home life. With the recent advances in pervasive technologies, including wireless sensor networks, there is growing interest in how to instrument home settings to automate aspects of the home, as per a 'smart home' scenario, e.g., [3, 21], and to monitor activities, often with a concern for the care and safety of older people in the home, e.g., [22]. Here the focus is much more on the home as a site for technology deployment to aid home management via automation or occupant management via activity monitoring.

However, while maturing, many of these technologies are still at early prototype stage. There are few examples of long-lived deployments in 'everyday homes' rather than purpose built smart homes. Often where everyday homes are used, there is still access to considerable expertise from the university or research lab undertaking the deployment e.g., [23]. Grinter et al's [5] findings about the work to make home networks work, where people with advanced expertise are involved, and our own studies of routine problems with current technologies in the home [24], suggest that there will be many practical issues to be solved for yet more advanced ubiquitous applications in the home.

Complementing the focus on the home as a unit of analysis, there is also considerable work looking at the interplay of work and home [25, 26], and indeed school and home, around technology use. For example, Venkatesh and Vitalari [27] contribute to the literature on teleworking/telecommuting by studying patterns of supplemental working at home often out of hours and at the weekends and that this was positively related to personal computer ownership and the portability of work. Sellen et al [9] refer to these as "crossover activities" and further point to the ways that home also permeates work as well as work permeating home. Others have looked at the relationships around technology between home and school. Downes [8], for example, looks at the different discourses around computer use in the home and school and the their implications for learning practices.

Work and school, along with informal peer networks, have been identified as key resources for learning about consumer technologies currently in the home. In particular the home is noted as being an important site of informal learning about technologies. Downes [8] notes the home as providing "opportunities for spectatorship and apprenticeship within the family [...] mainly available to children who had older brothers and sisters". Selwyn [10] also notes that "formal learning in the workplace also appeared to be inherently entwined with informal follow-up learning at work and home". He goes on to talk about "sustained informal learning networks" and "warm experts" that can include extended family and friends/social networks as well as co-workers who can act "as sources of help when using a computer at home".

The study that we will discuss here also finds many cases of such informal networks and use of "warm experts". However, the findings also suggest that there are much more subtle influences and diffusions from work into the home based on what people are familiar with, what skills they develop in the workplace and what

skills they can access from the workplace. School provides yet another diffusion path. These result in a set of informal influences across work, school and home that are directly implicated in what technologies get brought into the home and how they are managed. Given the directions that technology research for the home is taking, it also raises interesting questions for where future influences and learnings will come from. We go on now to introduce the study and to review the findings around the influences of work/school on home technologies.

3 Study Overview – Participants and Methods

A series of in-home studies were undertaken as part of a larger research program to design novel ubiquitous applications for domestic environments. The goal of the studies was to establish a baseline understanding of the homes and people we wanted to design with and for. In the process we also wanted to gain a better understanding of the current practical issues surrounding everyday technologies. We have reported elsewhere on the routine troubles people have with everyday technologies and sensors in the home [24]. Here we focus on unpacking the influences and interdependencies created between home and work and home and school in terms of diffusion paths and exposure to technologies, skill development and expertise.

We recruited 19 people from 10 UK households, via mailing lists and connections of friends and colleagues, to participate in this study (see Table 1 for an overview of the households). Participants were remunerated £25 for their involvement. All the adult participants were middle class by English standards – they were professionals or worked in clerical roles in support of professionals and had a university education.

Table 1. Profile of participant households (Pseudonyms used)

House-hold	Primary occupants (Ages)	Adult professions
1. Megan & James	Couple, mid 30's, two children 6 and 8	Teacher, technology company director
2. Emily & Thomas	Couple, late 20's	Admin assistant, software developer
3. Chloe & Jack	Couple, late 50's	Admin assistant, teacher
4. Charlotte & Joshua	Couple, mid-30's, four children 3, 5, 10, 12	Human rights consultant, homemaker
5. Sophie & Daniel	Couple, mid 60's	Retired astronomer, homemaker
6. Lauren & Harry	Couple, late 30's, three children 8, 10, 14	Technology company director, homemaker
7. Lucy & Sam	Couple, in 60's	Retired engineer, homemaker
8. Greg & Jane	Couple, in 40's, 1 boy, 13	School assistant,

		charity worker
9. Gladys	Woman, in 60's	Retired clerk
10. Dora & Owen	Couple, in 30's two boys, 8 and 15	School assistant, software engineer

A study session with each household consisted of an in-home tour and interview with one or two of the adult family members (subsequent in-home design sessions were also held with participants but are beyond the scope of this paper to discuss). Each session lasted approximately 90 minutes and was conducted by two researchers and captured on video. A study protocol was developed focusing especially on the current relationship of participants to the technology in their homes. Participants were asked to give the interviewer a tour of the house and discuss the technology in each room. The participants were asked how each piece of technology came to be there, what it was used for, and if there were any problems or issues with it. (As it turned out, these tours are similar in approach to that used in other home studies [28, 29].) As interviews were informed by literature from other ethnographic studies on the home, e.g., [13], we also asked questions about areas, activities and artifacts that had been identified in these studies as potential candidates for digital augmentation. Analysis of the videos was conducted through transcription, repeated viewing and identification of recurring themes, using a grounded theory approach [30].

4. Work/school influences on technology into the home

We focus our discussions here on findings related to the effect that work (or indeed, its absence) and school have in deciding the kinds of technologies, practices and expertise that are present in the home and the networks of people involved in managing those technologies. These findings contribute further detail and cases to the growing understanding of technologies in the home and the influences between home, work and school [8, 9, 10, 25]. They also provide a timely basis to reflect on the implications of such influences for emerging ubiquitous technologies in the home. We present the findings in the following themes: technology paths into the home; influence of implicit external requirements; standards and expectations; work as a source of expertise and skills; and what happens when you don't work.

4.1 Technology paths into the home

Hindus [1] argues that one of the key differences between home and the workplace is that people are consumers not knowledge workers. While we certainly saw many examples of consumer-like behaviour across our participants in their choice of technologies for the home [24], i.e., making "purchases based on aesthetics, fashion and self-image" [1], work also created another set of factors in those choices, factors that are often not foregrounded in a 'consumer-driven' view. Hindus [1] also suggests that "the diffusion path for technology is from workplaces to home". While more recent studies suggest that there is also a diffusion path from the home to the

workplaces, as with instant messaging (IM) [31], for the discussions here we focus on the paths into the home and how this worked out for the participants in our study.

In many cases, the diffusion path from work to home is based simply on familiarity. Often the work people did put them in contact with specific products which served to 'bias' or influence their own choices of technology. Problems can be created though when that familiarity isn't shared by others in the household. For example, Lauren's husband Harry ran his own company that installed wireless networks. Knowledge and enthusiasm for wireless networking had encouraged him to install an 802.11-based music system but Harry was the only person who could actually operate this, and it needed to be done from his work laptop. In another case, James ran his own mobile marketing company. He was therefore interested in having the latest 3G (third generation) mobile phone as his work handset and included a handset for his wife as part of the contract. Only after he had been using the handset for several months did he realize that 3G handsets actually performed poorly in an area of poor 3G coverage, as with where they lived, compared to a GSM handset. His wife Megan was not even aware that she had a 3G handset.

Familiarity was also sometimes associated with a perverse loyalty even when that loyalty created problems because of commitments to technologies that weren't actually performing as required. For example, Joshua worked as human rights consultant. He bought Acme [pseudonym] printers only because Acme was one of his clients, even though he had persistent problems with another of their products.

Joshua: I had to send it back to the factory and it had to be fixed. [Acme] Corp are one of my clients actually, so one of the reasons I buy their stuff, even though they're not doing very well at the moment, I sort of have a brand loyalty for the companies that I work with on the human rights front.

The above are examples of work-influenced consumer choices. People also had technologies in the home where they had little choice in selecting the technology because it was work-allocated. For example, the laptops in houses 3 & 8 were acquired or given to the person as part of their job.

Chloe: That laptop is Jack's work laptop... and also he's just discovered today that he might be able to get a computer under this new computers for teachers scheme, we might not even have to pay for it.

Greg: The laptop is a loan-stroke-purchase, well it's got a purchase option on it. It came as a result of me doing a university degree that was partially subsidized by [...] a government organization. And the deal is that I can have it for three years and then at the end [...] I've got the option to buy it.

Unsurprisingly, even though laptops and other technologies were acquired for work purposes, once in the home, they were often put to a range of uses by others and became a shared resource.

Greg: My son uses it [laptop]. He talks to his friends on MSN... he mainly uses it for social reasons, really. He does do some homework on it. My wife uses it for all sorts of different things: photography, letter writing, things like that. And I use it – the bulk of my university work is on it.

Influence of implicit external requirements
While some diffusion paths into the home were more explicit, either by individual influence and choice or by work allocation, others were more subtle, often by virtue

of implicit external expectations or to take advantage of opportunities for interactions between the home and work or school.

External bodies often set up priorities and requirements for certain technologies in the home but these were not formalized in some contract. Instead they were requirements implicitly entailed in the practical achievement of their work. These often served to set certain timeframes and standards for the technology and had financial implications in the provision of the technology and ongoing maintenance implications. In the following, for example, work and work-related education is cited as a reason for needing to have broadband installed:

Greg: We've just recently had broadband installed because... I have to look up research papers etc. I have to access, part of my course, is via the internet where we have virtual tutorials and seminars which I have to contribute to.

The interactive whiteboards at Megan's school have direct implications for how she prepares her lessons. Given that a lot of her preparation work happens at home, they also have implications for how she makes use of her personal technologies:

Megan: We do all our planning on computers, in school we've got interactive whiteboards. I'd often plan a lesson, and then take it, put it on a memory stick and then plug it into the laptop. It's a real laborious thing because I can't get my laptop to work with the interactive whiteboard for some reason.

Technology standards and expectations set at schools can create other implicit pressures about technology provision in the home and create home 'work' to acquire and maintain that technology in the home. While schools provide students with access to the technologies that they expect them to use, students will also want to work from home. Hence even though the school might not explicitly require every household to have a computer and internet connection, there is strong, albeit implicit, pressure to have them. Electronic homework submission is one example. Joshua and Charlotte's youngest daughter was expected to submit her latin homework by email, which she wanted to do from home once she had completed it. This class, with small numbers, was only possible because it could be taught across several schools using distributed computing technologies.

Work issues can also influence technology being brought into home life in other more subtle and indirect ways. The following examples are about technology choices being made to support the 'invisible' work of maintaining family relationships as a consequence of the time demands of work life. For example, Lucy cited other people's school and work schedules as a reason for wanting to use new communication technologies such as web cams. Lucy's son worked six days a week and so Lucy did not feel comfortable intruding on the scarce family time that her son had with his children. Instead she decided to use a webcam to enable her to still 'see' her grandchildren even if she couldn't physically visit them:

Lucy: Because now the [grand]children are at full time school and they're [twenty miles away] you're really sort of reliant on weekends or school holidays whereas I'd like to see them once a week and to be able actually to have a conversation and be able to see them rather than via the telephone.

Similarly James (house 1) cited the fact that he was regularly not home from work before his children went to bed as a reason for buying video-capable mobile phones for himself and his wife so that he could 'see' his children in the evenings.

Standards and expectations

Work was also a source of expectations for the basic standards of how technologies should work, also serving as drivers for upgrades in technologies. Chloe, for example, found that she could not put up with the poor performance of email from home over a dial-up connection because she was used to a well-supported fast email service at her workplace and now had a low tolerance level for poorly functioning services at home; this became one of their primary motivations for acquiring (their problematic) broadband.

Work influences on technology choices in the home can become problematic though when there are multiple often competing influences and 'standards'. This can particularly play out with software tools. One source of tension was the conflicting requirements of different home and work calendar systems, and the conflicting needs of being able to see across these calendars but also maintaining some separation between home and work. The other was when there were different systems that needed to interoperate. These were the case for Joshua. He worked with several different groups of people who all had different calendar systems and who all wanted to have networked systems:

> *Joshua: A big issue for me is I used to work for a company and they had a networked calendar system. I sort of went to computer-base calendar for appointments and I've kept that going although what I've never done is network that with different people that I work with all round the world. Although there's a lot of pressure on me from two of the organizations that I work with to network with their calendars.*
> *Int.: So why is it an issue? You don't want to network with their calendars?*
> *Joshua: [Laughs] Well, there's an element of that. And also, they have different systems. One company that I partly own has a web-based system…at the moment I still can't synchronize that with outlook. So that's an issue. The other people in Sweden would like me to do that [synchronize appointments in outlook] but I need to upgrade – I think – to Microsoft Office Professional to do that and I also have to open an MSN relationship with them,. But then I'm also slightly worried about them seeing my private calendar because it's got stuff on that's not to do with them, basically. That's an issue.*

4.2 Work as a source of expertise and skills

Perhaps even more important than work/school being influential in the choices of certain artifacts being in the home is the influence of work and school on the management and support of technology in the home by virtue of exposure to technologies in these settings. This plays out both in the skills that people in the home have as a result of their work, or the skills they are able to access in the workplace - Selwyn's 'warm experts' [10].

As also noted by Grinter et al [5], those people who had experience of working with technology as part of their jobs were often expected, by default, to be the one who 'knows how' to do the trouble shooting and management of technology in the home. In house 8 it was Greg's employment that resulted in the laptop being brought

into the home but it was his wife, whose job was the distribution and maintenance of technologies such as laptops and projectors for a local charity, who was expected to do the majority of maintenance of the laptop, along with their teenage son.

Greg: I'm not that technically minded, my wife's much more technically minded because she works much more on a daily basis with computers than I do, it's part of her job. So technical stuff tends to be sorted out by her.[...] I tend to use it specifically for what I'm doing... I think it's the amount of exposure, both my son and my wife are much more technologically minded than I am because they're both exposed to it a lot more than I am in my job and they both need it more in their jobs and schooling that I do in my job. So it falls – that's the order, Jane deals with most difficulties, my son has got very good insight into it and I just sit and listen basically [laughs].

Some of the other ways that workplace skills and knowledge play out in the home can be downright quirky. In house 2 Thomas has added a cardboard flap to the central heating control (as shown in Figure 1) to discourage his partner Emily from pressing the button that changes the central heating program. His idea to use the flap came from his experience working in the aviation industry:

Fig. 1. Heating control modified using principles from aircraft cockpit design

Thomas: This is my safety interlock. I quite like this feature. It's borrowed from the aviation industry where in cockpits in flight simulators and in aircraft they have gates to stop pilots accidentally flicking switches. And the idea is something like "Dump All the fuel" is obviously quite a last measure to take so that will have a gate round it and what I found is that Emily was controlling – [to Emily] you don't mind me saying this? Was controlling the central heating by switching the mode from the standard five times throughout the day into night setting or day setting. So what I did was, rather than just tape over it I put this cardboard flap here so that if she wanted to push that button she had to consciously lift that up. And the act of doing so makes her think – I think – that actually maybe I'd be better off pressing the temperature button.
Emily: Yeah – that has stopped me pressing that button.

Even when the people in the home did not have the skills themselves, work was still often used as a source of exposure to others with expertise. We saw numerous examples of people accessing informal work networks to help them with home problems. For example, Chloe frequently asked her technically-savvy work colleagues for help though sometimes in vain as was the case when they tried unsuccessfully to fix the problems with her broadband.

Family and friends were other sources of help for managing technology in the home. Here again, work was a factor in who they asked because the people they targeted were people who tended to have the necessary skills by virtue of their work or school experiences. For example, Sam who was retired asked his brother who was still working for help trying to get his webcam to work. Rode et al [16] discuss this in terms of a 'trade' where those who do not have these technical skills will require social skills in order to trade with those members of the family who do have the technical skills. This might not be a bad thing, as access to technical support from family and friends also functions as a kind of gift exchange and social 'glue' [32].

When you don't work – not 'keeping up'
All of the above point to the importance of 'exposure' in the workplace or at school for acquiring skills and experiences or being able to have access to the 'warm experts' with the skills. This raises the interesting question then of what happens if you don't work and don't have access to experiences or experienced others for keeping up with technologies. The following examples illustrate the ways in which retirement and staying at home to care for children can result in a certain amount of isolation from technical expertise that is not easily redressed.

At a very basic level, we can see the impact of a lack of a diffusion path from work to home - the two retired couples were the only households in the study not to have a wireless network and a laptop in the home.

However, the diffusion from work into the home isn't just about the technologies per se but also about the ability to keep up to date. Daniel retired five years ago and Sophie has been a homemaker for 20 years. Even though there was a PC in the house, Sophie did not know how to use it: "I'm completely ignorant, I'm ashamed to say"; she still made extensive use of the telephone and letters to keep in touch with people rather than email or IM. Her husband Daniel, a retired astronomer, was now faced with the problem that, in retirement, he no longer had access to technical support for the non-standard partitioning of his home PC.

Daniel: What else do I use it [PC] for? Well, I used to use it for my work, when I first retired, it was partitioned with a linux section, with all my programs that I used to use, which were put on computer for me. In fact that's going to be a crisis for me now because I have to have that done specially by somebody I know, because the computer people [at the local computer store] didn't know anything about linux or partitioning it for linux.

Lucy and Sam are also both retired, and found that they relied on either (expensive) dedicated professionals or Sam's brother to provide technical support:

Sam: He [brother] still works and he's a bit more up on the technology 'cos I retired... ten years ago it left me all behind. I had an old MSDos computer, so I'm learning windows again and just coming up to speed. And coming up to where I was ten years ago I suppose.

This wasn't just an issue for retired people. As a full-time mother/homemaker Charlotte felt that she was faced with the task of assessing the risks of the new technologies that her daughters were getting familiar with at school but was aware that she was struggling to keep track of the latest developments in internet communication technologies such as chat programs. This particularly became an issue when the older daughter, Jenny, setup a personal website.

Joshua: The thing that really worried us was the website…there's a picture of our twelve-year-old daughter with you know, images that she's found on the website but you know "Sexy babe" and all these other things and it's really quite – whoa! Does she know what she's doing here?

Similar to people who are retired, Charlotte didn't have access to a professional workplace to gain exposure to such technologies; for her it was her children who often performed this role.

Charlotte: It's just that MSN is the fashion at her age – talking on there and setting up your own website…she's our oldest so we don't know how new this is. I'd never heard of MSN.

Even though Joshua worked outside the home and was the one who eventually addressed the issue of the website, he was also aware that they didn't really know how to deal with it. In the end, Charlotte and Joshua could only manage to take down the offending website with the help of their younger daughter, using her expertise gained from friends at school to access the website, and then leaving a warning message pretending that it had come from the site administrator.

Scenarios such as this create interesting tensions in families. As has been discussed by Grinter and Eldridge [33], it is the work of teenagers (or as in the case we discuss here, pre-teenagers) to maintain their social-life and in support of that to understand the in-vogue methods of communication. However, parents also see it as a fundamental part of the work of parenting to restrict access to technologies that they feel produce a negative effect on their children [6]. Both of these kinds of 'work' can come into conflict and can shift the balance of power between parents and children when children have more 'know-how' surrounding the technology and parents are learning from their children. If parents haven't been able to gain the knowledge in advance from another source (such as their own workplace), they are always playing 'catch-up' and often resorting to work-around solutions.

5. Discussion

The studies just discussed build on others' work about the diffusion path into the home [1] and indeed, while beyond the scope of this study to report, complement work about the diffusion path from the home to work [31]. Through illustrative examples, we have discussed a range of different ways in which the technological landscape of work and school permeate and influence the technological landscape of the home, both in terms of how technologies get into the home and how technologies are managed once in the home. While the general principle of the influences between home and work and home and school is not new, the studies here provide further data for how these play out and also point to more nuanced and subtle ways that exposure to work/school can influence technologies in the home.

It is interesting to reflect here on the role of recent technology advances around portable mobile technologies and wireless networks as enablers of these changing relationships and blurring boundaries. When computers are fixed to an office desktop location, the sphere of influence is more likely to be limited to the mobility of people rather than technology, e.g., through the skills and know-how people bring home. Now the technology can also be carried between home and work and others at home can use it directly, developing their skills and experiences with new types of technology. The easy availability of networking also sets up implicit requirements that people should be able to connect out to work/school from home with the inherent requirements for new technologies to do this.

These new capabilities create implicit but very real 'invisible work' demands (involving time, money and skill) on people in the home because of decisions being made in workplaces or schools. If you want your child to be able to submit homework electronically or do research on the web, there is the invisible work, and the financial commitment, to purchase, install and maintain a working technology environment; the equivalent technical set-up some years ago in an office environment would have had people with specialized skills to do this work. In the home, there is no designated IT department and it becomes a similar story to that of "more work for mother" [34] where increasing technological sophistication perversely can result in more not less work: implicit, unaccounted and highly skilled work for which there is no formal training or support structure.

More generally though, and with a view to future trends, the technologies in the homes we have discussed are relatively stable consumer technologies and services: PCs, laptops, calendar systems, chat tools, email, websites, webcams, broadband networks. Further they are generic technologies, equally 'at home' in the office as well in domestic environments. While they are adaptable enough to be put to very different purposes in the different settings, the core aspects of the technologies enable skills and experiences to be transferred between settings.

What happens then when we start to look at the next generation of proposed technologies for the home? If we take the visions of the 'home of the future' seriously, as characterized by some of the 'smart home' work [35] as well as some of the 'aging in place' work [22], homes will be places with hundreds of sensors, wireless networks, and interacting devices and displays.

Many of these home applications, while using emerging toolkits and components [36], are nonetheless relatively bespoke for the particular domain problem, e.g., to monitor activities of daily living of an older person with cognitive impairment [22] or to enable remote interactions with the appliances of the home [23]. Where will people gain the exposure to, and experience with, similar technologies to help them choose and manage these technologies in their homes? Apart from manufacturing settings that make use of technologies such as RFID etc, it isn't clear that there will there be similar applications of the same ubiquitous technologies in the workplace as an avenue for exposure and learning. To date very little ubiquitous computing research has been targeted at workplaces. Instead, home and public spaces have been the settings of choice. Further, many applications have more ludic and playful purposes than those one would expect to be useful in a workplace. Will there be analogous applications of ubiquitous computing in the workplace, as has happened for example with the move of chat from home to work settings? And will such

applications become 'ubiquitous' enough that there is critical mass of skills and expertise among 'warm experts' [10] to call upon or will these be niche areas?

Early explorations show that schools rather than workplaces may well be the first places that people have exposure to, and can gain experience with, next generation ubiquitous technologies. The Ambient Wood [37] and Chawton House [38] projects, for example, make use of ubiquitous ensembles of mobile wireless networks, sensors and handheld devices for novel interactive learning experiences in outdoor environments and so it is easy to imagine that children will have greater familiarity with these technologies. As with the case of Charlotte and Joshua's website problem, this may well exacerbate shifts in know-how and control within families.

6. Conclusion

Understanding current experiences with technologies in the home, and the relationships between home and work and home and school, can be useful for anticipating issues with next generation technologies. This paper has contributed to this understanding by presenting case-based data that both reinforces current understandings about access to expertise in the workplace and school, as well as further unpacking the ways in which the home is situated within a network of influences and relationships with work and school. The ubiquity of experiences with common consumer technologies between work, school and home provides a foundation for influences to move between work and school into the home. These influences can be quite explicit in terms of what technologies people buy or have use of but can also be more subtle in terms of the expectations people have or the implicit requirements set up by the capabilities of technologies and the different ways that work and school lives integrate with home life.

Given the increasing interest in ubiquitous and tangible technologies for the home, as played out in next generation home automation and home monitoring scenarios, interesting questions arise about how future ubiquitous technologies will come into the home and how people will gain the exposure and experience to help them manage these technologies in the home. Where will the future influences and learnings come from? We suggest that future prototype deployments of ubiquitous technologies in 'everyday' homes need to take these questions as part of the research agenda so that such deployments are not just about whether a certain application is acceptable in that setting but what are the skills and resources required to manage and maintain that application in the home and where will these come from.

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