

# HCI Research in the home: lessons for empirical research and technology development

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**Information and communication technologies have begun to permeate our home environments under the auspices of the ubiquitous and mobile computing and information appliance movements. Yet the home is a very different environment to the workplace which has been the focus of the majority of HCI research. We have relatively few studies of information behaviour within the home or of data gathering methods that will allow researchers to investigate current domestic information and communication practices and needs. In parallel with this, there are a number of issues arising from designing technology for the home environment that are specific to the particularities of home life. Our experience in such a study of data collection and technological intervention within the home environment has provided detailed insights into these issues and problems, and we report on these here, presenting suggestions for future research programmes within the home.**

*Keywords: Shared displays, home life, communication, user studies, interaction design, multimodal.*

## 1. INTRODUCTION

The on\_message@home project is investigating household communication to support the design of a home-based messaging system, and to do this we have been examining communication practices and information sharing between members of the home. We use the term 'messaging' in its broadest sense, to include notes, voice messages, reminders, to-do lists and photographs that have been placed for viewing by others, as well as more formal communications, much as the family refrigerator and other notice boards or corkboards are used for. The implications of this research have led to the development of a prototype messaging system through which users can remotely 'post' messages to situated displays (situated, because display content is location specific) in their homes. We are prototyping a heterogeneous device environment for message posting, with mobile telephones sending SMS (text) and MMS (multimedia) messages, mobile devices connecting over Bluetooth or Wireless LAN (for example, to send photographs or mp3 files), remote web access via a PC over the Internet (to send notes, post interesting documents or other files), and by 'posting' messages through local and remote voice-based media (through a dedicated voicemail account). These multimedia messages can then be viewed on wall-mounted, interactive, displays that allow family members to view, create, retrieve, sort, discard, move and repurpose the material on them. This 'ecology' of appliances provides a complex platform for use and design, and we have focused our efforts on domestic messaging behaviour and patterns of use around this technology set.

A number of technical concerns arise out of designing such a system, but our primary concern has been on user interaction with the device set: this has taken two forms. 1) To develop interaction designs and principles for interface design to ensure the technology supports its users' needs and that it can be used without becoming a demanding cognitive task. 2) To evaluate interaction around the set of devices, for example, enquiring if, why and how the technology changes family roles and relationships, and alters the balance of power within the family; how it may become a focus for certain types of information; how the device is appropriated for playing games and in jokes; whether it improves (or not) family event co-ordination; and how it affects the previously tacit monitoring and policing activities that family members may engage in. So what makes the home so different from the workplace? It has been argued that the methods that we use to communicate in the home are practically no different to those of the workplace. The resources and mechanisms (both social and physical) that we have available to us at work to interpret and act through are the very same ones that we employ at home. What differs is the context of use: the activities that users engage in and the household relationships create a related, but distinctly different, set of requirements for home-based IT systems.

## 2. STUDYING IT IN THE HOME ENVIRONMENT

In this section, we cover what we have found to be the important issues in studying and understanding a particular aspect of IT in the home environment (i.e. a multi-modal messaging system). These are many and diverse, and cover technical, interactional and social problems. When developing for the home, we have faced particular problems in making use of the existing devices in a networked system. Specifically, we have faced problems with getting the complex technology to interact with one another: the appliances that we use are often early on in their

design lifecycles (for e.g., a GSM terminal/mobile telephone, PDA or Bluetooth), and development software (e.g. powerful and flexible APIs and SDKs) is simply not available, or requires substantial programming effort in order to perform simple actions that are not a part of the basic set of actions expected by their developers. The integration of multiple consumer devices onto computers, has also occasionally resulted in software/driver incompatibilities, and some consumer technology manufacturers have actually prohibited certain uses of their devices, denying us the opportunity to use them flexibly – a problem compounded by not putting this information in their pre or post-sale documentation. Other devices and software packages are not possible to control through high-level prototyping software, such as Macromedia Director. For a small team of interaction designers and social scientists, this is not a trivial problem. An example of this has been in integrating MMS and voicemail via a GSM Terminal. Of course, we can simulate this, but the purpose of the prototype is to investigate real world activities, and to develop any real understanding of practice, we need to have a semblance of the system's actual functionality.

Yet to place the problematic technological issues at the core of system development would be a mistake. The key concerns that we face in developing an effective design, as might be expected from an interaction-oriented project, centre around social issues. This is not to say that they are 'problems' as such, but they are aspects that may be problematic for the household to resolve, and may impact on the acceptance of the technology in the long run (or even rejecting an initial deployment of the prototype). As we have implied earlier, just because a technology is simple and does not greatly alter the functional activities of the household it can still have the potential for social disruption. This could occur through subtle changes to family roles (e.g. by distributing the role of the information gatekeeper) and relationships (e.g. enhancing displays of affection by allowing remote others to interact with those at home, and enriching the methods they can use). Some of these changes have the potential to shift the balance of power within the family or household. There is also a potential that explicit and publicly visible representation of communication could affect the previously tacit information monitoring and policing activities that adult or controlling family members may engage in. This is not to say that any of these resulting behavioural changes is negative, or that they are undesirable result of the study – we are as interested in understanding the transformative effects of networked communications technology at home as we are in developing useful and usable designs. By transforming activity, technology can provide fascinating insights about how family relationships operate, much as an ethnomethodological breaching experiment [1] can tell us about the maintenance of social order by breaching the commonly-held-to-be-true 'rules' of the home.

Another matter of concern to the households being investigated, and this may relate to any commercialised design, lies in privacy, and access to content. It is perhaps of greater concern to households for the prototype, who have opened access to their information by researchers. This is partly that they may have issues of embarrassment in opening up their private worlds, but also because this technology may allow access to sensitive information that could be useful to burglars or nefarious others (e.g. phone numbers, children's photographs, calendar information about when they might be on holiday, information that might be used against them in court). Even the integration of a web camera in the system to record video messages has given rise to questions about who might be able to access a video stream remotely (thieves, paedophiles or stalkers). These are serious practical issues to resolve if we are to ensure this technology has any hope of being installed. It must be remembered in these circumstances that household users may not be fully aware of the potential of the technology (which might be very limited in practice) in a way that technology developers would scoff at. Yet to get such a technology set adopted into the home will require these concerns to be addressed. Indeed, some of these concerns may be grounded in a very real danger, and they are not ones that we should attempt to explain away or deny.

### 3. EMPIRICAL STUDIES IN THE HOME

Until recently there has been little interest within computing and technology studies [2] in the area of domestic computing, but a number of studies of home life with an orientation towards Ubiquitous Computing, HCI and CSCW have begun to produce findings which can provide designers with an insight into the potential for domestic and leisure technology. These studies cover a broad spectrum of everyday domestic life, from mediating intimacy [3] to 'mothers work' [4], and calendar use [5] to the organisation and use of paper mail [6]; [7]. Within this growing research interest into the home, there is a thread of interest in which has begun to point towards the roles that different display surfaces play in the home, and we have extended this to look at the role of messaging in display surfaces. To do this, we have had to carefully review our data collection methods and the ethical dilemmas of data collection within domestic and family environments.

Our study was based around home visits to a broad mix of 10 homes, made up of a total of around 45 people (with occupancy varying slightly over the study). They included families with children, single occupant homes, homes with intergenerational occupancy or guests, and shared homes; participants came from a variety of ethnic backgrounds, occupations, incomes and age ranges, and worked in both traditional nine-to-five working patterns and in shift work, so that different patterns of communication were necessary. These homes are not intended to offer up statistical data, but to capture a varied set of domestic configurations and forms of occupancy that are

more or less representative of typical UK domiciles in an unashamedly qualitative study of practice. The initial pre-deployment study was carried out over multiple visits, involving interviews with household members, asking about their communication activities. We asked them to keep a photo-diary of all “messages” made, whether written notes, or objects that were put in a particular place for someone else to see. Participants were also asked to keep a video diary if possible, but all 10 households declined, but did not mind the videoing of their homes at every visit. This research is ongoing, and we have conducted a series of ‘experimental’ technology probes [8] to date.

What has to be recognised is the difficulty in gaining access to homes. Our experience was much different to that described in [9], where the interest for public participation was very high. This possibly has to do with the recruitment method; Crabtree and Rodden had recruited through an advertisement in a national newspaper, whilst in our study, we relied on “snowballing”: recruitment information was circulated via mailing lists to members of staff and students in our department, approximately 500 people, and was also forwarded to other lists by some of them. Although some respondents were interested and got in touch, when discussing it with members of their home they had to pull out. A lot of time was spent in negotiations before finalising the first visit, with one case with a first visit set-up when the family pulled out. Participants who were originally hesitant admitted that they felt uncomfortable with the idea of being asked about how they do things at home and the nature/content of their messaging activities. They were also concerned that some questions would be too personal and intrusive. Usually halfway through the first visit, participants admitted that they had been apprehensive, but relaxed when they realised the actual nature of the study. However, as social relationships built up with the participants, subsequent visits were usually easier.

Another of the concerns that we were particularly worried about was the involvement of minors in the study. Given their heavy use of existing communications technologies, they were likely to be important users of the technology, yet this raised questions as to investigating a) what and to whom they were sending messages, b) how we might question them about messages that were interesting, but perhaps sensitive, especially when their parents might not approve of this ‘illicit’ content, and c) how we might question those children about their activities without putting ourselves in a position of potential accusations about our probity and to reassure potential families that we have responsible motives, whilst at the same time, collecting interesting and useful data about messaging activity. Whilst these are clearly important issues, we have yet to encounter them in the main part (although to an extent c) is still relevant), as we have not evaluated the prototype in homes yet. However, this does have serious implications for us, and it may help to use diary information that is not monitored directly by the parents, although this will necessarily require their consent.

#### **4. DESIGNING NETWORKED IT FOR THE HOME**

Here, we cover issues and problems in designing IT for the home environment. These are both interactional (problematic relationships arising between the interface and the particular context of the home), and social (problematic relationships arising from the provision and increased visibility of information within the home). Of course, we recognise that these may be interrelated with one another. We do not necessarily provide solutions here, but suggest where problems lie that may require attention in design.

##### **4.1 Interactional issues**

It needs to be remembered that any home-based system is accessible, and may be utilised, by people of different ages, physical and cognitive abilities, and even physical stature. Designing such systems could be enormously problematic, in providing a high enough level of functionality to support complex use, through simple actions at the interface. Here, the information appliance design principle of ‘single in function, open in use’ may be of benefit, allowing simple and non-technical interactions to be built up into patterns and contexts of use that support more sophisticated activities (e.g. [10]). There are other appliance-related issues in networked systems of devices: to give the user a consistent ‘feel’ across the device range, at some level, there should be consistency across input types, and consistency across the media displayed. This has implications for the usability of the system and for the ways that information from the various devices can be combined and integrated together.

In any information-limited system (either storage and/or screen real-estate) that has a shared interface, and for which the content is which is not ‘owned’ by someone, there is the potential for a ‘tragedy of the commons’ effect. There are clearly information management issues in the design of any such system, to ensure that a shared screen resource does not become clogged with visual material and overloaded to the point that it is unusable. There are potential ways to resolve these, such as supporting the use of social protocols to ensure responsible action, or to automate an information archival process, but this should be used with caution, as automation may not fit with existing patterns of home life.

Finally, there is an important role for the representation of metadata in contextualising information in the media used. For e.g., when the on\_message system receives a SMS text message, the message is visibly ‘stamped’ with sender information, as a photograph and/or a phone number, the time received, and the type of message that it is

(SMS). All of this information allows the readers of that content to interpret it within a context: is it still temporally relevant? Is it of concern to them? Should they treat it as a request for action? Should they reply to the sender?

#### 4.2 Social issues

By making information that would otherwise be held in physical (and consequently, access-limited) repositories, we open this information up to more public access than it would previously have been. Within the home, examples of this includes making a child's private materials visible to their parents, when the child may or may not be fully aware of this. Indeed, it is the nature of much IT technology that this access to content is not fully transparent. As designers, we do need to ensure that where information content is, or will be made publicly available from the networked devices, this should be visible at the point of creation, and users should have the ability to delete content. One way to achieve this (and which is the approach that we have selected) is to open up all content to access by all devices within the home – minimising the risk of this confusion.

Another concern about the social effects of networked IT in the home that concerns us is the potential impact of the technology in facilitating antisocial behaviour, which for e.g. in the family home could involve bullying. These concerns give rise to management issues, not necessarily of content control, but of content management: who can access and remove information held on the system. Of course, this is similar to a paper-based system, many of which we have seen in the homes we visited. However, there is a difference here, in that electronic systems can be more invisible to external monitoring and 'social' policing, and thus are open to what may be deemed as less responsible patterns of use.

The home is not a 'blank canvas' that researchers can place information or technology in without regard for its residents' preferences. There is a real issue here in where to place screens (or other hardware), and homeowners may have strong feelings about where research prototypes or eventual technology might be placed. This may be based on an aesthetic preference, or a pragmatic one in which they do not wish for large objects to be drilled into their walls. In our work, this has led to limits being placed on screen size and display placement, although it remains to be seen whether this is a long term issue: it may be that the perceived value/utility of an eventual system, based on the householders' further experience of the system will lead to accommodation in this respect. Related to this, there is an important point to be made about aesthetics in the home: what is an aesthetic experience (visually, or through the nature of the device interaction) can clash with what we take to be the criteria associated with usability. We can see this in the design of devices such as the mobile telephone and iPod, where the aesthetics of the device form and its interaction methods may override suboptimal interaction designs.

#### Acknowledgments

This work was funded by Microsoft Research. We would especially like to thank Alex Taylor, Laurel Swan, Abi Sellen and Richard Harper for their help in informing and conducting this research.

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